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## THE AMBOINA FUNGI COLLECTED BY C. B. ROBINSON

By H. SYDOW

*Of Berlin, Germany*

The Robinson collection of fungi is not large but is especially interesting because it is the first collection made in Amboina. On the whole, judging from the species that are at hand, the fungus flora of this island is closely related to that of the Philippines, as various forms referable to the Basidiomycetes and to such genera as *Meliola* and *Asterina* occurring in the Philippines are especially numerous.<sup>1</sup>

### BASIDIOMYCETES

#### POLYPORUS Micheli

##### POLYPORUS BICOLOR Jungh.

Amboina, Way tommo, *Reliquiae Robinsonianae* 2244, August 17, 1913, on a fallen log; Negri lama, *Reliquiae Robinsonianae* 2304, September 8, 1913, on rocks, being a zonate form.

#### POLYSTICTUS Fries

##### POLYSTICTUS SANGUINEUS (L.) Mey.

Amboina, Batoe merah, *Reliquiae Robinsonianae* 2243, July 20, 1913, on decaying logs.

<sup>1</sup> For other publications on Doctor Robinson's Amboina collections see: Merrill, E. D., An Interpretation of Rumphius's Herbarium Amboinense, Bureau of Science Publ. 9 (1917) 1-595; *Reliquiae Robinsonianae*, Philip. Journ. Sci. 11 (1916) Bot. 243-319; Van Alderwerelt van Rosenburgh, C.R.W.K., The Amboina Pteridophyta collected by C. B. Robinson, op. cit. 101-121, t. 5, 6; Brotherus, V. F., The mosses of Amboina, op. cit. 12 (1917) Bot. 73-80; Beccari, O., A new species of *Calamus* from Amboina, op. cit. 81; Radlkofer, L., A new species of *Guioa* from Amboina, op. cit. 83; Smith, J. J., The Amboina Orchidaceae collected by C. B. Robinson, op. cit. 249-262.—EDITORS.

**POLYSTICTUS AFFINIS** (Nees) Fr.

Amboina, Hitoe lama, *Reliquiae Robinsonianae* 2090, October 11, 1913, on dead wood.

**POLYSTICTUS XANTHOPUS** Fr.

Amboina, *Reliquiae Robinsonianae* 2052, on dead wood.

**POLYSTICTUS DISCIPES** Berk.

Amboina, Salahoetoe, *Reliquiae Robinsonianae* 2108, November 27, 1913, on old logs.

**POLYSTICTUS MELEAGRIS** (Berk.) Cke.

Amboina, Hitoe lama, *Reliquiae Robinsonianae* 2442, October 11, 1913, on dead wood.

**POLYSTICTUS OBSTINATUS** Cke. forma **RESUPINATA**.

Amboina, Batoe merah, *Reliquiae Robinsonianae* 2106, July 20, 1913, on decaying log.

**FOMES** (Fr.) Cooke**FOMES ADAMANTINUS** Berk.

Amboina, Ayer putri, *Reliquiae Robinsonianae* 2111, July 28, 1913, on dead trees.

**GANODERMA** Karsten**GANODERMA AMBOINENSE** (Lam.) Pat.

Amboina, *Reliquiae Robinsonianae* 2052, on dead wood.

**GANODERMA TORNATUM** (Pers.) Bres.

Amboina, *Reliquiae Robinsonianae* 2050, on dead trees.

**TRAMETES** Fries**TRAMETES CORRUGATA** (Pers.) Bres.

Amboina, Way tommo, *Reliquiae Robinsonianae* 2055, August 7, 1913, on fallen log.

**TRAMETES STRIGATA** (Berk.) Bres.

Amboina, Paso, *Reliquiae Robinsonianae* 2110, October 29, 1913, on dead wood.

**HYMENOCHAETE** Lévêillé**HYMENOCHAETE CACAO** Berk.

Amboina, Way tommo, *Reliquiae Robinsonianae* 2053, August 7, 1913, on dead tree.

**HIRNEOLA** Fries**HIRNEOLA CORNEA** (Ehrenbg.) Fr.

Amboina, Kati kati, *Reliquiae Robinsonianae* 2192, October 7, 1913, on corticated fence post.



## UREDINACEAE

## HEMILEIA Berkeley et Broome

## HEMILEIA VASTATRIX Berk. et Br.

Amboina, Paso, *Reliquiae Robinsonianae* 2190, July 20, 1913, on leaves of *Coffea arabica*.

## AECIDIUM Persoon

## AECIDIUM KAERNBACHII P. Henn.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2220, July 17, 1913, on leaves of *Ipomoea* sp.

## URED O Persoon

## URED O KYLLINGIAE P. Henn.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2217, July 25, 1913, on leaves of *Kyllingia brevifolia*.

## ASCOMYCETES

## MELIOLA Fries

## MELIOLA EUGENIAE Syd. sp. nov.

Amphigena, plagulas primitus orbiculares 2–3 mm diam. dein confluyendo subinde irregulares aterrimas formans; mycelium densissime reticulato-ramosum, ex hyphis obscure castaneo-brunneis 8–10  $\mu$  crassis compositum; hyphopodia capitata numerosissima, recta, integra, 17–20  $\mu$  longa, cellula superiore 9–11  $\mu$  lata; hyphopodia mucronata non visa; setae mycelii numerosae, rectae vel subrectae, simplices, sursum attenuatae, sed apicibus obtusis, tota longitudine opacae, 200–300  $\mu$  longae, basi 9–11  $\mu$  latae; perithecia globosa, 200–220  $\mu$  diam.; asci bispori; sporae oblongae, utrinque late rotundatae, obscure castaneo-brunneae, opacae, 4-septatae, vix vel leviter constrictae, 44–52  $\mu$  longae, 22–25  $\mu$  latae.

Amboina, Kati kati, *Reliquiae Robinsonianae* 2163, October 6, 1913, on leaves of *Eugenia caryophyllata*.

## MELIOLA AMBOINENSIS Syd. sp. nov.

Hypophylla, plagulas orbiculares 3–8 mm diam. formans; mycelium reticulato-ramosum, ex hyphis castaneo-brunneis 7–9  $\mu$  crassis rectiusculis vel curvatis compositum; hyphopodia capitata numerosa, alternantia, integra, 24–32  $\mu$  longa, cellula superiore ovata 12–14  $\mu$  lata, basali brevior stipitiformi; hyphopodia mucronata non visa; setae myceliales copiosae, simplices, rectiusculae vel leviter falcato-curvatae, tota longitudine opacae, ad apicem semper acutae, 300–650  $\mu$  longae, basi 9–10  $\mu$

crassae; perithecia globosa, in sicco collapsa, 150–200  $\mu$  diam.; asci 2- ad 3-spori, fugaces; sporae cylindraceae, utrinque obtusae, castaneae, 4-septatae, non vel vix constrictae, 33–36  $\mu$  longae, 13–15  $\mu$  latae.

Amboina, Gelala, *Reliquiae Robinsonianae* 2150, September 19, 1913, on leaves of *Aganosma* sp.

**MELIOLA FAGRAEAE** Syd.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2134bis, November 5, 1913, on leaves of *Fagraea speciosa*.

**MELIOLA PACHYCHAETA** Syd. sp. nov.

Epiphylla, raro hypophylla vel petiolicola, plagulas orbiculares 4–8 mm diam. velutinas aterrimans formans, mycelium ex hyphis dense reticulato-ramosis et intertextis 7–10  $\mu$  latis brunneis septatis (articulis 10–20  $\mu$  longis) compositum; hyphopodia capitata copiosa, alternantia vel opposita, cylindracea, recta vel subrecta, 20–24  $\mu$  longa, cellula superiore majore integra vel raro leviter irregulari 10–12  $\mu$  lata, hyphopodia mucronata non visa; setae mycelicae copiosae, rectae vel subrectae, simplices, tota longitudine omnino opacae, ad apicem acutae, 600–1000  $\mu$  longae, basi 15–18  $\mu$  latae; perithecia gregaria, globosa, 175–250  $\mu$  diam.; asci 2- vel 3-spori, fugaces, sporae cylindraceae, utrinque obtusae, 4-septatae, leviter constrictae, brunneae, 36–42  $\mu$  longae, 12–15  $\mu$  latae.

Amboina, Batoe merah, *Reliquiae Robinsonianae* 2059, August 24, 1913 (type); Koesoekoesoe sereh, *Reliquiae Robinsonianae* 2246, August 7, 1913, both on leaves of *Semecarpus cassuvium*.

*Meliola pachychaeta* seems to be related to *M. aliena* Syd. from which it differs especially in the much larger setae.

**MELIOLA STEMONAE** Syd. sp. nov.

Epiphylla, plagulas minutas orbiculares 1–3 mm diam. formans; mycelium matrici dense adpressum, radians, ex hyphis brunneis 7–11  $\mu$  crassis ramosis septatis compositum, hyphopodia capitata modice copiosa, alternantia 18–22  $\mu$  longa, cellula superiore 15–18  $\mu$  lata, integra, recta vel curvata, cellula basali minore; hyphopodia mucronata non visa; setae mycelii copiosissimae, rectae vel leviter curvatae, 600–800  $\mu$  longae, basi 10–12  $\mu$  latae, tota longitudine opacae vel subinde ad apicem dilutiores, ad apicem dentibus 1–3 irregularibus acutis vel obtusis plus minus longis subinde brevissimis usque 20  $\mu$  longis erectis praeditae, subinde sed raro etiam subter apicem dente singulo praeditae; perithecia gregaria, in sicco collapsa, atra, 150–250  $\mu$  diam.; asci 2- ad 3-spori; sporae oblongae, utrinque rotundatae,



4-setatae, ad septa leviter constrictae, fuscae, 44–51  $\mu$  longae, 17–20  $\mu$  latae.

Amboina, Hitoe lama, *Reliquiae Robinsonianae* 2230, October 8, 1913, on leaves of *Stemona tuberosa*.

**MELIOLA ROBINSONII** Syd. sp. nov.

Amphigena, plerumque epiphylla, plagulas minutas 1–3 mm diam. tenues subinde confluendo majores formans; mycelium dense reticulato-ramosum ex hyphis brunneis 7–10  $\mu$  crassis septatis formatum; hyphopodia capitata copiosa, alternantia vel opposita, 20–24  $\mu$  longa, recta vel cellula superiore integra curvata 10–14  $\mu$  lata, cellula basali brevi; hyphopodia mucronata opposita, lageniformia, usque 23  $\mu$  longa; setae myceliales numerosae, rectae, opacae vel dimidia parte superiore pellucidae, 200–300  $\mu$  longae, basi 7–9  $\mu$  latae, ad apicem dentibus 1–4 erectis mox brevissimis mox longioribus (usque 15  $\mu$  longis) acutis praeditae; perithecia globosa, 150–175  $\mu$  diam., in sicco collapsa; asci 2- ad 3-spori; sporae oblongae, utrinque rotundatae, 4-septatae, ad septa vix vel leviter constrictae, brunneae, 40–44  $\mu$  longae, 18–20 latae.

Amboina, Soja, *Reliquiae Robinsonianae* 2119, August 2, 1913, on leaves of *Entada phaseoloides*.

**MELIOLA MEGALOAETA** Syd. sp. nov.

Amphigena, praecipue hypophylla, plagulas 0.5–2 cm latas primitus orbiculares dein irregulares et saepe confluendo majores formans; mycelium reticulato-ramosum, ex hyphis atro-brunneis opacis 9–12  $\mu$  crassis rectiusculis compositum; hyphopodia capitata sat numerosa, integra, 26–35  $\mu$  longa, cellula superiore rotundata, plerumque recta, 16–20  $\mu$  lata, inferiore brevi; hyphopodia mucronata solitaria vel opposita, numerosa, lageniformia, in collum plus minus abrupte producta, usque 32  $\mu$  longa, basi ca. 10  $\mu$  crassa; setae myceliales numerosae, rectae, rigidae, praelongae, 1,000–1,500  $\mu$  longae, basi 12–17  $\mu$  latae, atrae, opacissimae, ad apicem tantum dilutiores et saepe pellucidae, sive simplices obtuse attenuatae vel rotundatae, sive dentibus 2–4 irregularibus erectis acutis brevissimis vel elongatis usque 15  $\mu$  longis praeditae; perithecia pauca in quaque plagula, globosa, 200–250  $\mu$  diam.; asci 2- ad 3-spori; sporae oblongo-ellipsoideae, utrinque rotundatae, centro crassiores, atro-brunneae, subopacae, 4-septatae, ad septa non vel vix constrictae, 48–51  $\mu$  longae, 22–24  $\mu$  latae.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2078, October 13, 1913, on leaves of *Kibara moluccana*.

**MELIOLA ODONTOCHAETA** Syd. sp. nov.

Amphigena vel caulicola, plagulas aterrimas primitus orbiculares 2–4 mm diam. dein irregulares confluentesque formans; mycelium reticulato-ramosum, ex hyphis rectiusculis vel leviter undulatis brunneis 7–8  $\mu$  crassis compositum; hyphopodia capitata copiosissima, alternantia, 22–28  $\mu$  longa, integra vel subintegra, cellula superiore oblonga recta vel curvata 10–13  $\mu$  lata, inferiore breviori stipitiformi; hyphopodia mucronata opposita, rara, 20–26  $\mu$  longa, basi 8–10  $\mu$  lata; setae myceliales copiosae, rectae vel leviter curvatae, 600–800  $\mu$  longae, basi 10–12  $\mu$  latae, tota longitudine opacae, ad apicem dentibus 2–6 mox brevissimis et 1–2  $\mu$  tantum longis, mox elongatis usque 12  $\mu$  longis erectis praeditae, paucae subinde ad apicem obtusae haud denticulatae tuncque dilutiores immixtae; perithecia globosa, in sicco collapsa, 200–220  $\mu$  diam.; asci 2- ad 3-spори; sporae oblongae, utrinque rotundatae, brunneae, 4-septatae, 44–50  $\mu$  longae, 16–20  $\mu$  latae, cellulis mediis latioribus.

Amboina, Hitoe lama, *Reliquiae Robinsonianae* 2187, October 8, 1913, on leaves of *Dischidia* sp.

**MELIOLA CANARII** Syd.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2072, July 18, 1913, on leaves of *Canarium commune*.

**MELIOLA CLAVULATA** Wint.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2129, July 31, 1913, on leaves of *Ipomoea pes-caprae*.

**MELIOLA DESMODII** Karst. et Roum.

Amboina, Hitoe lama, *Reliquiae Robinsonianae* 2256, November 1, 1913, on leaves of *Desmodium gangeticum*; Ayer putri, *Reliquiae Robinsonianae* 2180, July 28, 1913, on leaves of *Desmodium umbellatum*.

**MELIOLA MANGIFERAE** Earle.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2118, November 5, 1913, on leaves of *Mangifera indica*.

**MELIOLA PELLICULOSA** Syd.

Amboina, Paso, *Reliquiae Robinsonianae* 2185, October 31, 1913, on leaves of *Lumnitzera racemosa*.

**MELIOLA SAKAWENSIS** P. Henn.

Amboina, Soja, *Reliquiae Robinsonianae* 2124, August 4, 1913, on leaves of *Clerodendron speciocissimum*.



## APPENDICULELLA Von Hoehnel

## APPENDICULELLA CALOSTROMA (Desm.) v. Hoehn.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2115, July 23, 1913, on leaves of *Rubus fraxinifolius*.

## PARODIELLA Spegazzini

## PARODIELLA PARAGUAYENSIS Speg.

Amboina, Batoe mera, *Reliquiae Robinsonianae* 2184, July 20, 1913, on leaves of *Desmodium triflorum*.

## DIATHRYPTON Sydow genus novum

Mycelium superficiale, copiose evolutum, ramosum, septatum, hyphopodiatum. Perithecia ad hyphas mycelii orta, ovato-globosa, astoma, cellulosa, mollia, mox et facile histolyse mucosa dissoluta, monoascigera. Asci aparaphysati, octospori. Sporae bicellulares, coloratae.

## DIATHRYPTON AMBOINENSE Syd. sp. nov.

Amphigenum, praecipue epiphyllum, plagulas tenerrimas atro-griseas variae dimensionis formans; mycelium copiose evolutum, ex hyphis rectis vel rectiusculis copiose et saepe opposita ramosis fuscis  $4-5\ \mu$  crassis septatis (articulis variae longitudinis  $8-25\ \mu$  longis) compositum; hyphopodia numerosa, unilateralia vel saepius et praecipue ad hyphas primarias crassiores opposita, continua, lageniformia,  $12-15\ \mu$  longa, basi  $5-7\ \mu$  crassa; perithecia dense gregaria, ad hyphas mycelii orta, ovato-globosa, astoma,  $45-60\ \mu$  alta, mollia, tenuiter cellulosa, pariete mox et facile histolysis ope in cellulas dilute brunneas rotundatas vel angulosas  $6-10\ \mu$  diam. dissoluto, monoascigera; asci ovato-globosi, octospori, aparaphysati,  $40-50\ \mu$  longi,  $35-42\ \mu$  lati; sporae ellipsoideo-oblongae, utrinque rotundatae, medio septatae et valde constrictae,  $21-26\ \mu$  longae,  $10-13\ \mu$  latae, loculis aequalibus vel supero subinde paullo latiore, facillime secedentibus.

Amboina, Hatalai, *Reliquiae Robinsonianae* 2092, October 24, 1913, on leaves of *Schuurmansia elegans*.

The new genus is closely related to *Phaeoschiffnerula* Theiss. from which it differs by the monoascigerous perithecia. These originate from the hyphopodia as is the case with *Ph. compositarum* Theiss.<sup>2</sup> We have seen a few isolated brown conidia, first two-celled, and later four-celled, measuring about  $20-26\ \mu$  by  $8-9\ \mu$ . Perhaps these have originated from the mycelium;

<sup>2</sup> Verhändl. Zool. bot. Ges. Wien (1916) 337.

this, however, could not be made out with absolute certainty. The brown hyphae of the mycelium are all connected by a very thin, nearly hyaline pellicle in which here and there slender, subhyaline or yellowish hyphae, 1-2  $\mu$  broad, are to be seen. We have found a similar pellicle in *Phaeoschiffnerula*.

AUERSWALDIA Saccardo

AUERSWALDIA EXAMINANS (Mont. et Berk.) Sacc.

Amboina, Kati kati, *Reliquiae Robinsonianae* 2228, October 28, 1913, on bark of decaying tree.

PHYLLACHORA Nitschke

PHYLLACHORA PHASEOLINA Syd.

Amboina, Kati kati, *Reliquiae Robinsonianae* 2154, October 6, 1913, on leaves of *Vigna* sp.

CATACAUMA Theissen et Sydow

CATACAUMA MICROPLACUM Syd. sp. nov.

Stromata hypophylla, irregulariter sparsa vel aggregata, irregulariter rotundata, minutissima, punctiformia, 0.33-0.5 mm diam., subinde bina confluentia et tunc paullo majora, periphere plana, opaca, centro convexa, unilocularia, clypeo epidermali, opaco; asci clavati, paraphysati, 45-60  $\mu$  longi, 11-18  $\mu$  lati, octospori; sporae 1- ad 2-stichae, ellipsoideae, continuae, hyalinae, 11-13  $\mu$  longae, 5-6  $\mu$  latae.

Amboina, Koeda mati, *Reliquiae Robinsonianae* 2257, on leaves of *Ficus* sp.

Related to *Catacauma apoense* Syd., but differing in the smaller stromata and spores.

CATACAUMA ROBINSONII Syd. sp. nov.

Stromata epiphylla, sparsa, plerumque orbicularia, 4-8 mm diam., opace atra, vesiculose convexa, ostiolis nitidis, multilocularia, haud raro stromate hypophyllo opposito sterili praesente; clypeo epidermali, opaco, 30-40  $\mu$  crasso; asci paraphysati, clavati, 50-80  $\mu$  longi, 11-18  $\mu$  lati, octospori; sporae monostichae vel distichae, ellipsoideae vel oblongae, continuae, hyalinae, 13-18  $\mu$  longae, 7-8  $\mu$  latae.

Amboina, Binting, *Reliquiae Robinsonianae* 2242, August 13, 1913, on leaves of *Ficus* sp.

This form, which is closely related to *Catacauma infectarium* (Cke.) Theiss. et Syd., is characterized by the regular stromata and the comparatively large spores.



## TRABUTIA Saccardo et Roumeguère

## TRABUTIA AMBOINENSIS Syd. sp. nov.

Stromata epiphylla, valde variabilia et irregularia, minora 2 mm tantum diam., majora usque 1 cm longa vel lata, plerumque in greges usque 2 cm longos irregulariter disposita et confluentia, opace atra, vesiculose convexa, ostiolis nitidis, clypeo opaco ca. 30–40  $\mu$  crasso; loculi copiosi, 350–420  $\mu$  lati, 150–250  $\mu$  alti, pariete brunneolo ca. 20  $\mu$  crasso; asci clavati, 60–80  $\mu$  longi, 11–20  $\mu$  lati, paraphysati, octospori; sporae mono- vel distichae, ellipsoideo-oblongae, continuae, hyalinae, 17–18  $\mu$  longae, 8–9  $\mu$  latae.

Amboina, Koesoekoesoe sereh, *Reliquiae Robinsonianae* 2096, October 3, 1913, on leaves of *Ficus hasskarlii*.

This species must be compared with *Trabutia Butleri* Theiss. et Syd. and *T. Elmeri* Theiss. et Syd. from which it differs but slightly in the form and arrangement of the very irregular stromata.

## HYSTEROSTOMELLA Spegazzini

## HYSTEROSTOMELLA TETRACERAE (Rud.) v. Hoehn.

Amboina, Amahoese, *Reliquiae Robinsonianae* 2212, September 16, 1913, on leaves of *Delima* (*Tetracera*) *Boerlagei*.

## ARMATELLA Theissen et Sydow

## ARMATELLA LITSEAE (P. Henn.) Theiss. et Syd.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2112, November 1, 1913, on leaves of *Litsea* sp.; Soja and Hatalai, *Reliquiae Robinsonianae* 2091, 2179, October 24, 1913, on leaves of *Neolitsea amboinensis* Merr.

## AULACOSTROMA Sydow

## AULACOSTROMA PANDANI (Rostr.) Syd.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2098, 2258, July 19, 1913, on leaves of *Pandanus*; Gelala, *Reliquiae Robinsonianae* 2107, September 19, 1913, on leaves of *Pandanus humilis*.

## ACTINODOTHIS Sydow

## ACTINODOTHIS PIPERIS Syd.

Amboina, Gelala, *Reliquiae Robinsonianae* 2208, July 16, 1913, on leaves of *Piper* sp.; Ayer putri, *Reliquiae Robinsonianae* 2235, July 29, 1913, on leaves of *Piper sarmentosum*.

## ASTERINA L  veill  

## ASTERINA SPECTABILIS Syd. sp. nov.

Amphigena, praecipue epiphylla, plagulas primitus orbiculares 2-4 mm latas dein subinde confluendo majores formans; mycelium copiose evolutum, ex hyphis obscure castaneis rectis opposita ramosis 8-11  $\mu$  crassis septatis (articulis 12-30  $\mu$  longis) compositum, hyphopodia copiosa, fere semper opposita, saepe longa serie regulariter disposita continua, crasse cylindracea, obtusa, integra, 10-20  $\mu$  longa, 9-12  $\mu$  lata; thyriothecia gregaria, rotundata, 200-300  $\mu$  diam., ex hyphis rectis 3  $\mu$  crassis septatis (articulis 10-16  $\mu$  longis) obscure brunneis contexta; asci ovato-globosi, aparaphysati, 50-80  $\mu$  longi, 40-50  $\mu$  lati, octospori, pauci in quoque thyriothecio; sporae oblongo-ellipsoideae, utrinque rotundatae, 1-septatae, ad septum constrictae, brunneae, leves, 35-42  $\mu$  longae, 18-20  $\mu$  latae, loculis aequalibus vel supero paullo latiore; pycnidia simul praesentia minora, rotundata, 90-140  $\mu$  diam., conidia ellipsoidea vel ovata, continua, obscure castaneo-brunnea, subopaca, 24-28  $\mu$  longa, 18-20  $\mu$  lata.

Amboina, Ayer putri, *Reliquiae Robinsonianae* 2126, July 28, 1913, on leaves of *Flacourtia inermis*.

## ASTERINA VENUSTULA Syd. sp. nov.

Epiphylla, plagulas orbiculares tenues 3-5 mm diam. formans; mycelium tenue, matrici dense adpressum, ex hyphis fuligineis laxae ramosis leviter undulatis vel subrectis 3-4  $\mu$  crassis remote septatis (articulis 15-30  $\mu$  longis) compositum; hyphopodia sat numerosa, unilateralia vel opposita, cylindracea, 10-15  $\mu$  longa, 4-4.5  $\mu$  lata, integra vel subintegra, continua, recta vel leviter curvata; thyriothecia dense gregaria, orbicularia, 150-175  $\mu$  diam., ambitu copiose undulato-fimbriata, ex hyphis radiantibus fuscis ca. 3  $\mu$  crassis strato singulo contexta, stellatim dehiscencia; asci ovato-globosi, aparaphysati, octospori, 32-40  $\mu$  longi, 25-30  $\mu$  lati; sporae oblongae, leves, brunneae, 20-23  $\mu$  longae, 8-9  $\mu$  latae, 1-septatae, loculis fere aequalibus.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2088, 2252, July 18, 1913, on leaves of *Averrhoa bilimbi* L.

## ASTERINA ASSIMILIS Syd. sp. nov.

Epiphylla, plagulas orbiculares 2-5 mm latas tenues formans; mycelium ex hyphis rectangulariter ramosis septatis (articulis 15-20  $\mu$  longis) 5-7  $\mu$  crassis obscure castaneo-brunneis compositum; hyphopodia modice copiosa, dispersa, alternantia vel unilateralia, continua, crasse cylindracea, 10-17  $\mu$  longa, 7-9  $\mu$



lata; thyriothecia gregaria, orbicularia, 200–300  $\mu$  diam., radiatim ex hyphis rectis ca. 3  $\mu$  crassis septatis (articulis 5–10  $\mu$  longis) brunneis contexta; asci ovati vel oblongi, 60–80  $\mu$  longi, 30–40  $\mu$  lati, octospori, aparaphysati; sporae ovato-ellipsoideae vel ovato-oblongae, infra medium septatae, hinc loculis conspicue inaequalibus, vix vel leviter constrictae, fuligineae, leves, 24–26  $\mu$  longae, 13–15  $\mu$  latae.

Amboina, Kati kati, *Reliquiae Robinsonianae* 2157, October 6, 1913, on leaves of *Eugenia caryophyllata* Thunb.

This species is closely related to *Asterina ditissima* Syd. from which it differs in the longer, cylindric, and less-numerous hyphopodia, and in the conspicuously unequal-septate spores.

#### ASTERINA DIAPHORELLA Syd.

Amboina, Wae, *Reliquiae Robinsonianae* 2147, November 26, 1913, on leaves of *Sideroxylon* sp. aff. *attenuatum*.

#### ASTERINA PUSILLA Syd.

Amboina, Paso, *Reliquiae Robinsonianae* 2181, October 31, 1913, on leaves of *Premna obtusifolia*.

#### ASTERINA SPONIAE Racib.

Amboina, near the town of Amboina, *Reliquiae Robinsonianae* 2161, July 27, 1913, on leaves of *Trema* sp.; Hitoe messen, *Reliquiae Robinsonianae* 2151, November 5, 1913, on leaves of *Trema amboinensis*.

#### PRILLIEUXINA Arnaud

##### PRILLIEUXINA LORANTHI Syd. nom. nov.

*Asterinella loranthi* Syd. in Philip. Journ. Sci. 8 (1913) Bot. 490.  
(Type from Leyte, Bur. Sci. No. 15243a, on leaves of *Loranthus leytenis*.)

Amboina, Koesoekoesoe sereh, *Reliquiae Robinsonianae* 2247, August 23, 1913, on leaves of *Loranthus rumphii*.

##### PRILLIEUXINA MICROSPILA Syd. sp. nov.

Epiphylla, plagulas minutas tenues orbiculares 1–3 mm diam. formans; mycelium ex hyphis irregularibus fuscidulis ramosis anastomosantibus septatis 3–4  $\mu$  crassis haud hyphopodiatis compositum; thyriothecia dense gregaria, copiosa, orbicularia, 150–200  $\mu$  diam., e strato singulo hypharum subrectarum fuscidularum 2–3  $\mu$  crassarum septatarum (articulis 4–6  $\mu$  longis) contexta; asci ovato-globosi, aparaphysati, octospori, 35–50  $\mu$  longi, 25–40  $\mu$  lati; sporae oblongae, utrinque late rotundatae, fuscidulae, leves, medio septatae et valde constrictae, 21–24  $\mu$  longae, 9–10  $\mu$  latae, loculis aequalibus vel supero leviter latiore.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2214, August 20, 1913, on leaves of *Leucosyke capitellata*.

**PRILLIEUXINA AMBOINENSIS** Syd. sp. nov.

Hypophylla, rarius etiam epiphylla, plagulas orbiculares vel irregulares 2–5 mm diam. formans; mycelium copiose evolutum, radians, ex hyphis septatis ramosis vel anastomosantibus obscure fuscis 4–6  $\mu$  crassis torulosis haud hyphopodiatis sed hinc inde ramulos breves hyphopodia simulantes emittentibus compositum; thyriothecia sat numerosa, gregaria, rotundata, 200–400  $\mu$  diam., ambitu fimbriata, opaca, subatra, ex hyphis ca 3  $\mu$  latis radiatim contexta, stellatim dehiscentia; asci ovati vel subglobosi, paraphysati, octospori, 45–60  $\mu$  longi, 25–45  $\mu$  lati; sporae oblongae, utrinque rotundatae, fuscae, medio septatae et valde constrictae, leves, 26–35  $\mu$  longae, 13–15  $\mu$  latae, loculis fere aequalibus vel supero leviter latiore.

Amboina, Hoetoemoeri Road, *Reliquiae Robinsonianae* 2174, September 30, 1913, on leaves of *Cordyline terminalis*.

The new species is most nearly related to the Philippine *Asterinella calami* Syd. from which it differs in the characters of the mycelium and in its smaller spores.

**PARASTERINA** Theissen et Sydow

**PARASTERINA MELANOTES** Syd. sp. nov.

Epiphylla, plagulas orbiculares conspicuas 4–8 mm diam. formans; mycelium ex hyphis rectiusculis intertextis ramosis septatis 8–10  $\mu$  crassis atro-brunneis compositum; hyphopodia sparsa, solitaria, hemisphaerica, ca. 10  $\mu$  alta et lata; thyriothecia dense gregaria, irregulariter rotundata, 400–700  $\mu$  diam., aterima, omnino opaca, centro valde elevata, radiatim contexta, peripherice hyphis obscure castaneo-brunneis 6–8  $\mu$  latis plus minus longe fimbriata; asci copiose evoluti, paraphysati, ovato-globosi, octospori, 60–85  $\mu$  longi, 50–60  $\mu$  lati; sporae oblongae, utrinque late rotundatae, leves, fusciculatae, 35–40  $\mu$  longae, 17–19  $\mu$  latae, loculis aequalibus vel supero paullo latiore.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2203, October 13, 1913, on leaves of *Polyosma brachyantha*.

**CALOTHYRIUM** Theissen

**CALOTHYRIUM VILE** Syd. sp. nov.

Thyriothecia nudo oculo aegre perspicua, epiphylla, in greges effusos laxae disposita, rotundata, 150–300  $\mu$  diam., radiatim ex hyphis flavo-fusciculis 2–3  $\mu$  latis contexta, mycelio libero perparco, ex hyphis undulatis vel torulosis 3–4  $\mu$  crassis haud hyphopodiatis composito, hymenio plano simplici pluriascigero; asci



clavati vel clavato-saccati, octospori, aparaphysati, 50–80  $\mu$  longi, 18–22  $\mu$  lati; sporae oblique monostichae vel distichae, obpiriformes vel elongato-obovatae, hyalinae, 1-septatae, non vel leviter constrictae, 18–24  $\mu$  longae, 9–12  $\mu$  latae, loculo supero majore.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2102, October 14, 1913, on leaves of *Phoebe macrophylla*.

#### LEMBOSIA Lévêillé

LEMBOSIA ROBINSONII Syd. sp. nov.

Epiphylla, plagulas irregulares usque 1 cm diam. vel confluendo majores formans; mycelium ex hyphis rectiusculis 7–10  $\mu$  crassis obscure castaneo-brunneis irregulariter reticulato-ramosis septatis compositum; hyphopodia sparsa, alternantia, cylindrico-elevata, continua, integra, 12–17  $\mu$  longa, 8–10  $\mu$  lata; thyriothecia laxe gregaria, primitus rotundata et 300–500  $\mu$  diam., mox autem exacte linearia et usque 1.25 mm longa et 200–300  $\mu$  lata, centro elevata, opaca, carbonacea, ambitu fimbriata, radiatim ex hyphis 3–4  $\mu$  crassis contexta; asci ovato-globosi, 70–90  $\mu$  longi, 35–55  $\mu$  lati, octospori; paraphyses distinctae, copiosae, ca. 2  $\mu$  crassae; sporae oblongo-ellipsoideae, utrinque rotundatae, leves, fuligineae, leviter constrictae, 34–38  $\mu$  longae, 17–19  $\mu$  latae, loculis aequalibus vel fere aequalibus.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2188 (type), 2158, both collected November 6, 1913, on leaves of *Eugenia* sp.

The species differs from *Lembosia eugeniae* Rehm in the characters of the mycelium, hyphopodia, and smaller spores. It is more nearly related to *Parasterina pemphidioides* (Cke.) Theiss., but differs notably in the exactly lembosoid form of the thyriothecia and the one-celled hyphopodia.

#### ECHIDNODES Theissen et Sydow

ECHIDNODES XENOSPILA Syd. sp. nov.

Epiphylla, partibus matricis atro-decoloratis et peculiariter quasi dendritice effiguratis usque 1 cm latis insidens; mycelium liberum parum evolutum, ex hyphis brunneolis ramosis anastomosantibus ca. 3  $\mu$  crassis fuscis haud hyphopodiatis compositum; thyriothecia laxe disposita, plerumque recta, linearia, 350–450  $\mu$  longa, 120–180  $\mu$  lata, rima longitudinali dehiscencia, contextu atro opaco radiato; asci ovati vel ovato-globosi, 35–45  $\mu$  longi, 30–35  $\mu$  lati, octospori; paraphyses haud numerosae, ad apicem leviter incrassatae, sporae conglobatae, oblongae, leves, ex hyalino fuscae, 1-septatae, vix vel parum constrictae, utrinque rotundatae, 22–25  $\mu$  longae, 9–10  $\mu$  latae, cellula superiore plerumque leviter crassiore sed brevior.

Amboina, Hitoe messen, *Reliquiae Robinsonianae* 2134, November 5, 1913, on leaves of *Fagraea speciosa*, growing together with *Meliola fagraeae* Syd.

THYROSOMA Sydow genus novum

Mycelium nullum. Thyriothecia superficialia, brunnea, ex hyphis radiantibus contexta, membrana basali distincta nulla, hymenia multa polyascigera includentia, polyostiolata. Asci in plectenchymate hyalino fibroso dein evanescente siti, sessiles, octospori, aparaphysati. Sporae hyalodidymae.

THYROSOMA PULCHELLUM Syd. sp. nov.

Thyriothecia amphigena, praecipue hypophylla, sparsa, solitaria, ambitu orbicularia, 1–1.5 mm diam., centro 80–100  $\mu$  crassa, plana, superficialia, centro opaca et pluristratosa, ad peripheriam tantum pellucida, ex hyphis amoene radiantibus rectis vel rectiusculis ca. 2  $\mu$  crassis peripherice brunneolis centrum versus obscurioribus septatis (articulis 8–14  $\mu$  longis, ad peripheriam longioribus) composita; asci sessiles, ventricosi, saccati vel elongati, 40–55  $\mu$  longi, 15–18  $\mu$  lati; sporae oblongae, hyalinae, circa medium 1-septatae, non constrictae, 16–18  $\mu$  longae, 5–6  $\mu$  latae, cellula superiore late rotundata paullo brevior et latior, cellula inferiore paullo longior sed angustior.

Amboina, Way tommo, *Reliquiae Robinsonianae* 2146, 2057, November 26 and August 17, 1913, on leaves of *Erythroxylum ecarinatum*.

EREMOTHECA Theissen et Sydow

EREMOTHECA PHILIPPINENSIS Syd.

Amboina, Hitoe, *Reliquiae Robinsonianae* 2175, October 8, 1913, on leaves of *Aporosa sphaeridophora*.

BYSSOGENE Sydow genus novum

Ascomata in hypothallo ex hyphis asperatis brunneis ramosis composito superficialiter insidentia, atra, in maturitate patelliformia, extus ad basim hyphulis obsessa. Loculi unistratosi, in parenchymate minute celluloso siti. Asci solitarii, ovati vel oblongi, aparaphysati, octospori. Sporae muriformes, hyalinae.

BYSSOGENE AMBOINENSIS Syd. sp. nov.

Hypophylla, plagulas primitus orbiculares 3–10 mm diam. tandem saepe confluentes tuncque irregulares et majores fumoso-brunneas formans; mycelium copiosissime evolutum, densum, ex hyphis brunneis vel opace brunneis ramosis remote septatis 4–5  $\mu$  crassis densissime asperatis compositum; ascomata in



mycelio superficialia, sparsa, primitus globoso-clausa, in maturitate patelliformia, margine elevato, atra, usque 1 mm lata, extus rugosa et praecipue ad basim hyphulis obsessa, parenchymatica, in superiore parte minute flavo-brunnee vel brunnee parenchymatica, in inferiore parte grossius et obscurius atre vel subatre parenchymatica, cellulis 5–7  $\mu$  diam.; loculi unistratosi, in superiore stromatum parte siti; asci ovati, oblongi vel subclavati, antice crasse tunicati, aparaphysati, 40–52  $\mu$  longi, 18–25  $\mu$  lati, octospori; sporae elongato-obovatae, superne late rotundatae, basim versus leviter attenuatae, sed obtusae, transverse 3-septatae non vel vix constrictae, loculis 2–3 vel omnibus septo longitudinali iterum divisis, hyalinae, 15–17  $\mu$  longae, 8–10  $\mu$  latae.

Amboina, Batoe mera, *Reliquiae Robinsonianae* 2105, September 24, 1913; Ayer putri, *Reliquiae Robinsonianae* 2170, July 29, 1913; both on leaves of *Eugenia* sp.

The new genus belongs to the Saccardiaceae; it is somewhat related to *Calopeziza* Syd., but differs especially in the black ascomata and colorless spores.

#### CALLORIOPSIS Sydow

CALLORIOPSIS GELATINOSA (Ell. et Mart.) Syd.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2156, July 28, 1913, parasitic on *Meliola* on leaves of *Cerbera manghas* (*C. odollam*).

#### PILOCRATERA P. Hennings

PILOCRATERA HINDSII (Berk.) P. Henn.

Amboina, Lateri, *Reliquiae Robinsonianae* 2222, September 5, 1913, on dead wood.

### FUNGI IMPERFECTI

#### DIPLODIA Fries

DIPLODIA FRUCTUS-PANDANI P. Henn.

Amboina, locality not given, *Reliquiae Robinsonianae* 2109, on fruits of *Pandanus dubius*.

#### ASTEROSTOMELLA Spegazzini

ASTEROSTOMELLA POLYSTIGMA Syd. sp. nov.

Epiphylla, plagulas primitus minutas et discretas mox autem confluentes et totam folii superficiem plus minus occupantes formans; mycelium ex hyphis rectiusculis sed dense ramosis 3–4  $\mu$  crassis septatis fuscidulis compositum; hyphopodia modice copiosa, continua, sessilia, valde et varie lobata, plerumque latiora quam altiora, 9–11  $\mu$  lata, 7–8  $\mu$  alta; thyriothecia copio-

sissima, dense gregaria, punctiformia, 60–85  $\mu$  diam., plerumque rotundata, radiatim ex hyphis 2.5–3  $\mu$  crassis rectiusculis crebre septatis fuscidulis contexta, stellatim dehiscentia; conidia continua, fusca, ovata vel piriformia, 14–17  $\mu$  longa, 10–13  $\mu$  lata.

Amboina, town of Amboina, *Reliquiae Robinsonianae* 2167, August 23, 1913, on leaves of *Hemigraphis* (vel *Peristrophe*?) sp.

GLOEOSPORIUM Desmazières et Montagne

GLOEOSPORIUM ALCHORNEAE Syd.

Amboina, Hitoe lama, *Reliquiae Robinsonianae* 2143, October 8, 1913; Amahoesoe, *Reliquiae Robinsonianae* 2237, September 18, 1913; both on leaves of *Alchörnea rugosa*.

PESTALOZZIA De Notaris

PESTALOZZIA PALMARUM Cke.

Amboina, Batoe mera, *Reliquiae Robinsonianae* 2065, July 20, 1913, on drying leaves of *Cocos nucifera*.

CLADOSPORIUM Link

CLADOSPORIUM ZIZYPHI Karst. et Roum.

Amboina, Binting, *Reliquiae Robinsonianae* 2145, November 18, 1913, on leaves of *Zizyphus jujuba*.

HELMINTHOSPORIUM Link

HELMINTHOSPORIUM FICINUM Sacc.

Amboina, Soja, *Reliquiae Robinsonianae* 2204, 2234, August 31 and August 2, 1913; Lateri, *Reliquiae Robinsonianae* 2114, September 5, 1913; Wae, *Reliquiae Robinsonianae* 2136, November 27, 1913; all on leaves of *Ficus wassa*.

APPENDIX

The following four numbers were collected by the late Doctor Robinson on the same trip, before reaching Amboina.

MELIOLA SAKAWENSIS P. Henn.

Boeton, Baoebaoe, *Reliquiae Robinsonianae* 2509, July 13, 1913, on leaves of *Clerodendron* (*minahassae*?). Celebes, Macassar, *Reliquiae Robinsonianae* 2466, July 11, 1913, on leaves of *Clerodendron* sp.

PHYLLACHORA CATERVERIA (Berk.) Sacc.

Boeton, Baoebaoe, *Reliquiae Robinsonianae* 2507, July 13, 1913, on leaves of *Ficus* sp.

PARASTERINA PEMPHIDIODES (Cke.) Theiss.

Celebes, Macassar, *Reliquiae Robinsonianae* 2468, July 11, 1913, on leaves of *Eugenia jambolana*.



## PHILIPPINE MANTIDS, OR PRAYING INSECTS

By F. WERNER

*Of Vienna University, Vienna, Austria*

ONE PLATE

Through the kindness of my friend Dr. H. H. Karny, I was enabled to examine a small but highly interesting collection of mantids, consisting of sixty specimens, collected by Prof. Charles Fuller Baker, of the College of Agriculture, Los Baños, Philippine Islands. For this courtesy I am much indebted to Professor Baker, and hope he will further devote a part of his time to the collection of mantids, as our knowledge of the Philippine species seems still very far from perfect, as can easily be seen when not less than six species out of twenty prove to be new to science.

Under the circumstances it is much too early to comment upon the geographical distribution of Philippine mantids; still many years of study will be required before we can say that we know the mantid fauna of Luzon alone. However, I hope that resident naturalists, seeing the remarkable effect of present collecting, will not cease to give attention to this interesting group of insects.

In the systematic arrangement of species I have followed Giglio-Tos, whose monographic works on mantids, based on very rich material, must be regarded as the foundation for future systematic work on the insects of this family. It is significant of the paucity of Philippine material in European collections that, among the immense numbers of new species described by Giglio-Tos, hardly a half dozen are from the Philippine Islands.

### EREMIAPHILINÆ

#### ***Metallyticus violaceus* Burmeister.**

Middle and hind femora dark at apex; abdomen entirely blue below; no red spots on head. The species has already been recorded from the same locality by Hebard.<sup>1</sup>

MINDANAO, Zamboanga, 1 female.

<sup>1</sup> Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 18.

## IRIDOPTERYGINÆ

*Tropidomantis tenera* Stål.

Eng. Resa Ins. (1858) 314.

The Philippine specimens agree in every respect with specimens from Java. Recorded from the Philippine Islands (Zamboanga) by Hebard.<sup>2</sup>

PALAWAN, Puerto Princesa, male and female. MINDANAO, Davao, 1 female.

## AMELINÆ

*Hystericomantis* g. nov. *aspera* (Stål). Plate 1, fig. 1.

*Gonypeta aspera* STÅL, Öfvers. Kongl. Vetensk. Ak. Forh. Stockholm No. 10 (1877) 38.

I have no doubt that this is the species very briefly described by Stål. Of the four conical tubercles on vertex the outer ones are much stronger than the median pair; besides these there are two prominent bicuspid tubercles between the bases of antennæ, and likewise a strong tricuspid tubercle near their level at inner margin of eyes. Pronotum strongly keeled, with abrupt rhomboidal dilatation in the middle, spinose at the margins, the median keel and the short keels of the prozone diverging cephalad from the transverse sulcus; anterior coxæ with strong spinose outer and lower keel; anterior femora distinctly longer than coxæ, with concave upper margins, flat outside, with blunt longitudinal keel; tibia short, with two outer and four inner spines, the latter increasing in length toward apex of tibia, the three outer curved; tarsus about twice as long as tibia; middle and hind legs very long and thin; wings reaching far beyond apex of abdomen, hyaline, somewhat infumated, elytra with very narrow costal area, apex washed with brown; some of the veins with dark brown points. The male seems to have been undescribed.

Due to the many striking features of head, thorax, and forelegs, the species deserves to rank as representing a distinct genus of the Gonypetinae, for which I propose the name *Hystericomantis*. It lacks the ciliation of the costal margin of forewing and the fine denticulation of anterior femora; the antennæ, however, are distinctly ciliated. It is not related to the genus *Myrcinus* as Giglio-Tos suggested, but is related to the Oligonycinae (*Haania*).<sup>3</sup>

<sup>2</sup> Op. cit. 21.

<sup>3</sup> According to M. Hebard the insect here described is not *Gonypeta aspera* Stål, but a member of the genus *Haania* and possibly *philippina* (Giglio-Tos). It should therefore be listed under Oligonycinae.—KARNY.



Total length, 20.5 millimeters; pronotum, 5; elytra, 17; anterior femora, 6.5.

LUZON, Mount Maquiling, 1 male.

*Hystricomantis dispar* sp. nov. Plate 1, fig. 2.

This nice little mantid differs, like the preceding, from all typical Gonypetinae by having the antennae but not the anterior wings ciliated and the anterior femora not finely denticulated at the base of the larger spines; head broad, with prominent, round eyes and rectangular frontal scute, the upper side somewhat arched; vertex rounded, with arched upper margin; pronotum short, smooth, distinctly dilated behind the transverse sulcus, metazone about one and a half times as long as prozone, lateral denticulation very fine; abdomen somewhat broader toward end in the female, parallel-sided in the male; anterior coxae smooth, with very fine spines, the interspace between the two larger ones filled with two very small ones; anterior femora strong, upper margins straight, lower angular; five outer spines, four discoidal spines; tibia strong, with ten outer and twelve inner spines; metatarsus as long as tibia; wings reaching far beyond end of abdomen, perfectly hyaline in the male (in the female the forewings are feebly infumated), costal part strongest; of the hind wings only the apex is brownish, with some darker points. Transverse veins in costal area oblique, nearly parallel, rarely divided; in the discoidal area wide-meshed, many of the transverse veins interrupted, the meshes nearly rectangular; body bright yellowish brown; unicolored in the male, whereas in the female the anterior coxa has a dark reddish brown, transverse band at apex and also one on the anterior femur; basal part of the latter with dark reddish brown longitudinal streaks reaching to discoidal spines; all spines of anterior femora dark at their points.

Length, male, 16 millimeters; female, 17; pronotum, male, 3.5; female, 4; elytra, male, 15; female, 18.

LUZON, Mount Maquiling, male; Mount Banahao, female: Tayabas Province, Malinao, female. MINDANAO, Davao, male.

According to M. Hebard this species is the same as *Amantis aeta* Hebard.<sup>4</sup> According to Karny the female is more intensively colored than the allotype and the color pattern more extensive, as shown by his fig. 2 *a*. As in the meantime I have had occasion to study Hebard's papers here mentioned, I fully agree with this statement.

<sup>4</sup> Op. cit. 31.

*Gonypeta borneana* Giglio-Tos.

Boll. Soc. Ent. Ital. 46 (1914) Florence (1915) 155.

Compared with specimens of *G. punctata* as defined by Giglio-Tos, from Java and Sumatra, the Philippine specimens distinctly show the specific differences. The granules on pronotum and outer portion of anterior femora are very strong and the coloration is distinctly darker, in one specimen nearly black; only the dimensions are somewhat smaller than indicated by Giglio-Tos.

MINDANAO, Zamboanga, 2 males.

## COMPSOMANTINÆ

*Compsomantis tumidiceps* (Bolivar).

Bolivar, An. Soc. Esp. Hist. Nat. 19 (1890) 303 (*Compsomantis*); Kirby, Ann. & Mag. Nat. Hist. 13 (1904) 83 (*Humbertiella ? brunneri*); Werner, Verh. Zool. bot. Ges. Wien. (1916) 258 (*Hapalomantis*); Giglio-Tos, Boll. Soc. Ent. Ital. 46 (1914) 86; Hebard, Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 36.

This species was first described from the Philippines, but occurs also on Lombok and Sumbawa Islands (Kirby, Werner). The present specimen differs slightly from a female from Lombok, in my collection, by a somewhat longer pronotum, probably owing to its sex. There is no doubt that Giglio-Tos is perfectly right in uniting this species with *Compsomantis crassiceps* De Haan and *Hapalomantis rufula* Westwood in the same group; the union seems very natural.

LUZON, Mount Maquiling, 1 specimen (probably a male, end of abdomen missing).

## THESPINÆ

*Euchomenella heteroptera* (De Haan).

Bijdr. Kenn. Orth. p. 78, pl. 18, fig. 1; Saussure, Mem. Soc. Gen. 21 (1871) 48; Giglio-Tos, Boll. Soc. Ent. Ital. 47 (1915) 34, 35.

This species seems not to have been found previously in the Philippine Islands, where only the rather closely related *Tagalomantis manillensis* Sauss. is known. It is easily distinguished from that species by its unicolorous, infumated wings. The specimen agrees perfectly with De Haan's figure, whereas the species figured as the female belongs, as Giglio-Tos has already pointed out, to quite another genus, called *Mythomantis* by that author. I have a specimen of the latter insect, *M. confusa* Westwood, from Java, that agrees in every respect with De Haan's figure.

LUZON, Tayabas Province, Malinao, 1 male.



## CALIRIDINÆ

*Leptomantis lactea* (Saussure).

*Miopteryx lactea* SAUSSURE, Mem. Soc. Gen. 21 (1871) 125.

LUZON, Laguna Province, Mount Maquiling, 1 female.

*Aetella bakeri* Hebard.

Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 45.

I had at first confounded this species with *Leptomantis albella* Burm.; but, after having received Hebard's excellent paper, I am convinced that I had before me the new species described by him as representing a new genus. This species cannot be rare and, in any case, it appears to be widely distributed over the Philippines. It is easily distinguishable from *Leptomantis lactea* by the smaller size and the perfectly hyaline, iridescent wings, whereas that species has distinctly milky wings with white costal margin on elytræ. A pair of dark spots, apparently common in *L. lactea*, is not frequently to be found in *Aetella bakeri* on the metazone of the pronotum, as far behind the transverse sulcus as the length of the prozone.

LUZON, Laguna Province, Mount Maquiling, 1 female, and Los Baños. BASILAN, 1 male. MINDANAO, Zamboanga, 1 female: Butuan and Dapitan.

## DEROPLATINÆ

*Deropletys philippinica* sp. nov.

Distinguished from all other members of the genus by the narrower pronotum, resembling somewhat in shape that of *Sphodrepoda medioconstricta* Wood-Mason. Prozone of pronotum one-third the length of metazone, the latter with a longitudinal median keel in its posterior half. The expanded part of the prozone is not more than half the transverse diameter of the prozone itself, narrowed cephalad and with rounded anterior margin; in its anterior third the metazone is parallel-sided, widens toward its second third, and is again narrowed to its posterior end, thus forming a sinuous line on each side; wings extending much beyond apex of abdomen, the anterior ones feebly dilated toward apex, which is bluntly triangular; costal area dilated only at base, the greater portion toward the apex very narrow; stigma distinct, small, triangular; hind wings with the costal area angularly produced (more so than the forewings); middle and hind legs very slender, with small, triangular, somewhat denticulated lobules near apices of tibiæ; exposed parts dead-leaf-colored above and below; inner face of

anterior femora with a large blackish spot before and somewhat behind the unguicular sulcus, and three dark vertical streaks toward apex, hind wings with a light yellowish brown spot before apex which is rather dark brown, like the base, and indistinctly dark spotted; anal area with lighter transverse veins; anterior wings indistinctly mottled with darker and lighter brown; middle and hind legs broadly banded with dark brown.

MINDANAO, Davao, 1 male.

Total length, 42 millimeters; pronotum, length, 15; breadth at broadest part of dilatation, 4; forewings, length, 30; breadth, 7.

#### MANTINÆ

*Tenodera aridifolia* Stoll.

Giglio-Tos, Boll. Soc. Ent. Ital. 1911 43 (1912) 37; Hebard, Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 50.

LUZON, Mount Maquiling, 2 males. MINDANAO, Iligan; Davao, 1 female, large specimen, 10 centimeters.

The Iligan specimen is somewhat darker brown, with a median longitudinal line on the pronotum. Curiously enough, this widely spread species seems not to have been found before in the Philippines.

*Tenodera fasciata* Olivier = *attenuata* Stoll.

Giglio-Tos, Boll. Soc. Ent. Ital. 1911 43 (1912) 45; Hebard, Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 51.

Apparently new for the Philippines.

MINDANAO, Zamboanga, 1 male.

*Hierodula vitrea* (Stoll).

Giglio-Tos, Mant. Esot. 5 (1912) 83.

Spines of anterior coxæ very blunt, scarcely distinguishable. Not recorded before from the Philippine Islands.

LUZON, Mount Maquiling, 1 male.

*Hierodula gigliotosi* sp. nov.

Frontal scutellum pentagonal, with parallel lateral and straight anterior sides and two feeble longitudinal keels, somewhat broader than high; pronotum elongate, its metazone more than twice as long as the prozone; lateral margins very feebly denticulated at the dilatation; posterior angles and margin rounded, blackish; organs of flight extending beyond end of body, elytra with opaque, bright green costal and perfectly hyaline discoidal part; hind wings perfectly hyaline; of the internal spines of anterior femora the first (from apex) and fourth are quite black, the sixth likewise black with a black spot



at base; the eighth, tenth, twelfth, and fourteenth have only the base black; internal spines of tibiae black at their tips, discoidal spines black at their bases; all other parts green; subgenital plate elongate, darker green.

Total length, 47 millimeters; pronotum, 16; anterior wings, 32. MINDANAO, 1 male.

This species is characterized by the absolute lack of spines on anterior coxæ, as is normally the case in the males of the genus *Ephierodula* Giglio-Tos; otherwise it is a true *Hierodula*, closely related to *H. unimaculata* Oliv. from Coromandel, Bombay, and Tonkin.

*Hierodula patellifera* Serv.

Giglio-Tos, Boll. Soc. Ent. Ital. 1911 43 (1912) 95.

LUZON, Mount Maquiling, a female; Los Baños, male and female.

The Los Baños female is of the green variety, the two others, of the grayish. The species has already been recorded from the Philippines, from Luzon, by Giglio-Tos. Hebard also records it from various localities in the Philippines.

*Ephierodula immaculifemorata* sp. nov.

This fine species differs from both other species of the genus<sup>5</sup> by the unicolorous anterior coxæ and femora and by the denticulated anterior coxæ of the male; but in all other respects it is a true *Ephierodula*. Frontal scute pentagonal, with rounded anterior edges; pronotum not denticulated laterally; metazone about three times as long as prozone; dilatation strong, well distinguished by a horizontal expansion of its margin, resembling somewhat the still stronger one of *Rhomboderula tamolana* Brancs<sup>6</sup> from New Guinea; wings extending much beyond end of abdomen; forewings with opaque green costal and glossy, hyaline discoidal part; stigma broadly surrounded by dark brown; hind wings hyaline, infumated; anterior coxæ with eight feeble spines; anterior femora with four outer and fifteen inner spines; eleven outer and fifteen inner tibial spines.

Total length, 65 millimeters; pronotum, 22; elytra, 50.

MINDANAO, Butuan, a male.

*Rhombodera ornatipes* sp. nov. Plate 1, fig. 3.

This fine new species is one of the group to which *Rhombodera major* belongs, characterized by Giglio-Tos as having the meta-

<sup>5</sup> Cf. Werner, Verh. Zool. bot. Ges. Wien (1916) 262 and 263.

<sup>6</sup> Jahresb. Ver. Trencsin. Cour. 19-20 (1897) 62, pl. 1, fig. 8.

zone of the pronotum at least two and a half times as long as the prozone, and the broadest part of the pronotum before its middle. It is, however, easily distinguished from all other members of this group by the coloration of the inner side of the anterior coxæ, which are deep and shining black on their apical half; also, the trochanter and a large spot at the basal hind quarter of the inner side of anterior femora are black, and there are several (about five) small black spots at the base of the inner femoral spines; the large femoral spots contain two whitish ones; the others are green; coxal spines small, irregular; outer femoral spines four, inner sixteen, the first (from apex), fourth, sixth, an eighth black, with a black spot at their bases; wings reaching to end of abdomen, anterior ones with opaque green costal, and hyaline discoidal areas; stigma small, elongate.

Total length, 49 millimeters; length of pronotum, 15; broadest part of pronotum, 6.5; length of forewings, 32.

LUZON, Mountain Province, Baguio, a male.

#### ARCHIMANTINÆ

*Statilia haani* (Saussure)<sup>7</sup> var. major var. nov.

Similar to the typical form of this common, widespread species, which has been previously recorded from the Philippine Islands by Saussure and by Brunner, but larger. It is also represented in my collection, by specimens from Samar and Mindoro. One female from Mount Maquiling is much larger and distinctly darker than the other, and the wings do not reach end of body, but otherwise it is not different.

LUZON, Laguna Province, Mount Maquiling, 2 males and 2 females; Los Baños, 1 male.

*Statilia pallida* sp. nov.<sup>8</sup>

This species differs from the preceding (it also has the dark postacetabular prosternal spot) by the uniformly colored inner side of anterior femora. I have examined large numbers of *S. haani* from Sikkim, Annam, Penang, Perak, Sumatra, Nias, Java, Lombok, Ceram, Formosa, and Japan; and, as the coloration of mantids generally, and of *S. haani* especially, is fairly constant, the specific separation of these two specimens

<sup>7</sup> Giglio-Tos, Boll. Soc. Ent. Ital. 1911 43 (1912) 6.

<sup>8</sup> According to M. Hebard this and the preceding species are *Statilia maculata*. Hebard says (in litt.): "The cephalic limb coloration is no specific criterion and is subject to decided variation."—KARNY.

Having examined more material in the meanwhile, I agree with Hebard's opinion.—WERNER.



seems to be justifiable. Color pale greenish; size about the same as the preceding species.

LUZON, Laguna Province, Mount Maquiling, a male; Los Baños, a male.

*Statilia nemoralis* (Saussure).

Giglio-Tos, Boll. Soc. Ent. Ital. 1911 43 (1912) 8.

Differs from *S. haani* by the shorter thorax without any trace of dark postacetabular prosternal band, the larger and more mesially situated dark band of anterior coxæ (on the base of coxæ in *S. haani*), by the broad dark band in the middle of anterior femora, and by the indistinctly margined stigma. The present specimen has the alæ not tessellated, as is the case in var. *infusata* Giglio-Tos.

PALAWAN, Puerto Princesa, a male.

#### ACROMANTINÆ

*Acromantis hesione* Stål.

Öfvers. Kongl. Vetensk. Ak. Forh. No. 10 (1877) 38. Hebard, Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 73.

Costal margin of forewings bright green, hind wings yellowish, infumated at apex; otherwise pale reddish brown; outside of anterior femora darker, broadly trifasciated.

I at first took this species for *A. javana* Giglio-Tos, poorly described as the above-mentioned species. Besides, the specific name *javana* is preoccupied by *Acromantis javana* Sauss., which is an *Odontomantis*. The name must therefore be changed, and I propose *Acromantis lilii*, in honor of that great student of the Mantidæ, whose name "Giglio" means "lily."

Total length, male, 22 millimeters; forewings, 17; female, about 27.

LUZON, Laguna Province, Los Baños, male and female.

*Acromantis luzonica* Hebard.

Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 71.

Resembles much a female of the Neotropical *Phyllovates parallela* (De Haan) in form and coloration of the wings, the anterior wings being grass green, the costal area bent down at a distinct angle, the discoidal area with an oblique dark spot; posterior wings yellow. Here we have another case of similarity between the Ethiopian *Calidomantis savignyi* Sauss. and the Neotropical *Parastagmatoptera flavoguttata* Serv.

LUZON, Mountain Province, Baguio, 2 females.

*Phyllothelys bakeri* sp. nov.

Near *Phyllothelys westwoodi* Wood-Mason, but with the spines of anterior coxæ minute, and the lateral denticulation of pronotum very weak; anterior femora less slender and not fasciated, lobes of intermediate and posterior femora strongly undulated. Elytra distinctly hyaline on their discoidal portion, veins alternately spotted dark and white, apex with brown spots, as also the hind wings, which are more distinctly infumated than the elytra. It is possible that this species may be identical with *P. decipiens* Giglio-Tos, but, as the number of coxal spines is greater (fifteen) and the author says nothing about the lobes of the middle and hind legs, the identification remains doubtful.

Total length, 39 millimeters; pronotum, 14.5; forewings, 23; anterior coxæ, 9; anterior femora, 9.5.

This new and interesting species is named after its zealous and successful discoverer, Prof. C. F. Baker.

LUZON, Laguna Province, Mount Maquiling, a male.

Possibly the males figured by Wood-Mason and Westwood as *Phyllothelys westwoodi* belong to two different species. The horn of the vertex in the figure by Westwood<sup>9</sup> is distinctly shorter, the pronotum laterally densely spinose, the anterior femora slenderer, and the lobes of the hind leg more denticulated.

#### HYMENOPODINÆ

*Odontomantis javana* (Saussure).

Mem. Soc. Gen. 21 (1879) 33, pl. 4, fig. 11. Hebard, Proc. Acad. Nat. Sci. Philadelphia 72 (1920) 77.

I can find no difference between these specimens and those from Java in my collection, nor can I detect any reason for separating *Odontomantis euphrosyne* Stål from this species.<sup>10</sup>

LUZON, Laguna Province, Mount Maquiling, 1 female: Nueva Vizcaya Province, Imugan, 1 female. PALAWAN, Puerto Princesa, 1 male. MINDANAO, Davao, 1 female.

*Creobroter urbana* (Fabricius).

Saussure, Mem. Soc. Gen. 21 (1871) 144.

Ground color of elytra darker green, the ocelliform spot more yellowish (not reddish).

<sup>9</sup> Rev. Ins. Fam. Mant., London (1889) pl. 1, fig. 3.

<sup>10</sup> M. Hebard says (in litt.): "Werner has apparently not noted the differences which at least warrant geographic racial recognition."—KARNY.



LUZON, Mount Banahao, a female, quite typical: Mount Limay, a female.

I have in my collection specimens from Java, Annam, Tonkin, and Siam, as well as some from Ceylon; from the last-named locality only *C. pictipennis* Wood-Mason seems to be recorded, and I have seen a specimen from Celebes (leg. *Sarasin*). I am unable to find any characters distinctive from those of *Creobroter meleagris* Stål.





## ILLUSTRATION

### PLATE 1

- FIG. 1. *Hystricomantis aspera* (Stål). *a*, head and pronotum, from above;  
*b*, head, front view; *c*, head, from above; *d*, fore parts, from side.  
2. *Hystricomantis dispar* sp. nov. *a*, anterior leg of female; *b*, anterior wing of male.  
3. *Rhombodera ornatipes* sp. nov. Anterior leg, inner side.





PLATE 1. PHILIPPINE MANTIDS.





# ADDITIONS TO THE HERPETOLOGICAL FAUNA OF THE PHILIPPINE ISLANDS, I

By EDWARD H. TAYLOR  
*Of Manila, Philippine Islands*

## SEVEN PLATES

New and rare frogs, lizards, and snakes have been found during recent herpetological collecting in parts of the Philippines. Although these collections were made prior to the actual publication of my monographs,<sup>1</sup> the descriptions could not be included therein because those books were in type. For this reason papers on these new collections will be published in the Philippine Journal of Science, of which the present is the first. The following notes from my field books show where the chief collections were made and collecting dates:

### NORTHERN LUZON

I returned to the Philippine Islands from the United States in 1920 and arrived at Manila on March 30. On April 11, I proceeded to Baguio where I joined Prof. H. Otley Beyer and Dr. Robert L. Schofield.

April 12. Specimens of *Kaloula rigida* sp. nov., *Rana luzonensis*, and *Sphenomorphus jagori* were collected near Baguio.

April 13. Our party left Baguio for the north, going by automobile to kilometer 14. Here I collected a few specimens of *Polypedates leucomystax*, *Rana luzonensis*, and *Rana magna*. We reached camp 30 in the evening.

April 14. An adult specimen of *Oxyrhabdium leporinum* was collected.

April 15. The day was spent in the vicinity of Haight's place, Pauai, but no reptile or amphibian was seen or heard. Mr. Haight said that frogs were occasionally seen.

April 16. Collecting along the trail between Haight's and camp 88 yielded neither amphibian nor reptile.

April 17. A specimen of *Cornufer subterrestris* was collected at kilometer 101. Professor Beyer left for Cervantes.

April 18. A specimen of *Peropus mutilatus* was taken in the presidencia of Subangan. Specimens of a *Mabuia* were shot near the trail.

<sup>1</sup> Amphibians and turtles of the Philippine Islands, Bureau of Science publication 15 [reprint from Philip. Journ. Sci.]. Manila (1921) 193 pp., 17 pls., 9 text figs. Snakes of the Philippine Islands, Bureau of Science publication 16. Manila (1922) 312 pp., 37 pls., 32 text figs. Lizards of the Philippine Islands, Bureau of Science publication 17. Manila (1922) 262 pp., 23 pls., 53 text figs., in press.

April 19 and 20. I collected in the vicinity of Bontoc and was disappointed because of the few specimens found. Doctor Schofield saw a turtle in the market, but it had disappeared before I could get it.

April 21. I left Doctor Schofield at Bontoc and set out for Balbalan, Kalinga.

April 23. Near Balbalan I found a specimen of *Hologerrhum philippinum*. I purchased a specimen of the mammal *Phloeomys pallidus*.

April 23. Near Balbalan I found a specimen of *Hologerrhum philippinum* and as a result amphibians began to breed. I collected large series of several species, some of which are new.

May 2 and 3. Balbalan to Bontoc. Very few specimens were collected.

May 5. I climbed Polis Mountain.

May 6. I arrived at Banaue.

May 7. Banaue to Kiangang. Amphibians were heard at night near Kiangang, but I was unable to collect any of them. Two young specimens of *Elaphe erythrura* were collected along the trail.

May 8. Kiangang to Nayan.

May 9 to 12. I collected *Kaloula picta* and several of the commoner lizards in this vicinity.

May 13. Nayan to Kiangang.

May 14. Kiangang to Tauang.

May 15. Tauang to Manhuyhuy. A small frog, probably *Cornufer meyeri*, was found dead near the trail.

May 16. Manhuyhuy to camp 59. Between kilometers 65 and 64 a large red frog jumped into the trail in front of me and from there into the cañon. This frog appeared to be an unknown species of *Rana*. The elevation at this place is about 2,500 meters. No frog has been recorded from so high an elevation in the Philippines.

May 17. Camp 59 to Baguio.

#### MANILA AND VICINITY

During May and June, 1920, I made numerous trips about Manila, to Mount Maquiling, and to Mount Banahao.

#### POLILLO AND CALOTCOT ISLANDS

July 8. I left Manila by rail for Hondagua where I took the steamer for Polillo.

July 9. I arrived at Polillo.

July 10 to 23. In the vicinity of the town of Polillo, I collected numerous specimens.

July 24. I went to Burdeos on the east coast of the island. A snake, probably a species of *Natrix*, was seen on the trail, but I was unable to capture it.

July 25 to 27. Some interesting specimens, including *Rana merrilli* sp. nov. and *Typhlops cumingii* (Gray), were collected near Burdeos.

July 27. I embarked in a small banca for Calotcot Island, which is about 25 kilometers east of Polillo.

July 28 to August 1. Calotcot Island is about 3 kilometers long and is heavily forested. There is a small clearing at the southern end. Eleven species of lizards and three species of snakes were taken on this island. No amphibians were seen. I returned to Burdeos during the night of August 1.



August 2 and 3. I collected at Burdeos.

August 4. I returned to the town of Polillo.

August 5 to 10. I collected in the vicinity of Polillo.

August 11. I went to Bislian in the southern part of the island. There I found several new species.

August 12. I returned to Polillo.

August 13. I left Polillo.

August 14. I arrived in Manila.

#### MINDANAO

September 23 to October 6. During this period I collected in the southern part of Zamboanga Peninsula, for the most part in the mountains along Tumugao River, including a two days' journey from the waterworks' intake. Only a few species were found. One specimen of the rare black and yellow cobra, *Naja samarensis*, and three or four frogs of undescribed species were collected.

#### BASILAN

October 7. I collected in the vicinity of Isabela. Through the kindness of Mr. Guy Holland, a lumberman of Isabela, I was taken by launch to Port Holland, the site of a sawmill on the western coast directly opposite Great Govenen and Little Govenen Islands.<sup>2</sup> I had visited this point in 1917 and had found several interesting specimens. At that time primeval forest covered the sites.

October 8 to 14. Port Holland. I found *Polypedates pardalis* and *Polypedates appendiculatus* while collecting at night. A good breeding series of *Kalophrynus stellatus* was taken. While here I was very kindly entertained by Mr. Hamilton, the sawmill manager, who facilitated my collecting in no small degree.

October 15 to 23. Abung-abung. Thanks to the kindness of Mr. Hamilton and Mr. Holland, I was enabled to visit a logging camp on the southern part of the island. It was an ideal collecting ground, and many specimens and species were taken, some of them unknown to me. A caecilian differing from *Ichthyophis weberi* was discovered and four specimens were taken. I had splendid success collecting at night. Returned to Isabela on the 23d and left for Zamboanga the same day, embarking there for Jolo on October 24, 1920.

#### JOLO

October 25 to November 16. This period was spent in making collections in the western half of Jolo. Visits were made to Mount Tuman-tangis, Bud Daho, Indanan, Camp Romandier, and a point near the central part of the island where the Government cattle ranch is situated. I am under great obligation to Capt. Francis Link, formerly of the Philippine Constabulary, who accompanied me on many of my trips. A specimen of the rare *Luperosaurus joloensis* was seen, but it escaped in a tall tree.

November 17. I sailed for Manila.

<sup>2</sup> The spelling of these names is that on Coast and Geodetic Survey maps. They are called Gouenan by the Yakans and Samals of the district.

## MOUNT MARIVELES

December 26, 1920, to January 1, 1921. I collected on the northern side of Mount Mariveles. Two specimens of the rare *Hologerrhum philippinum* were taken, but nothing else that was noteworthy.

## MOUNT MAQUILING

April 15 to June 1. During this period extensive collections were made on Mount Maquiling. A specimen of *Oxyrhabdium*, which is distinct from the two recognized forms, was taken, but it escaped from a faulty collecting bag.

Aside from collections made by myself I have obtained small collections from southern Leyte, Sibuyan, Romblon, Batan Island, Busuanga, and Balabac.

In this paper the following species are described as new:

## AMPHIBIANS

<i>Rana merrilli.</i>	<i>Philautus basilanensis.</i>
<i>Cornufer cornutus.</i>	<i>Kaloula negrosensis.</i>
<i>Philautus polillensis.</i>	<i>Kaloula kalingensis.</i>
<i>Philautus williamsi.</i>	<i>Kaloula rigida.</i>
<i>Philautus zamboangensis.</i>	<i>Bufo mcgregori.</i>

## LIZARDS

<i>Gekko porosus.</i>	<i>Sphenomorphus bakeri.</i>
<i>Gekko smaragdinus.</i>	<i>Siaphos herrei.</i>

## SNAKES

<i>Dryocalamus mccroryi.</i>	<i>Pseudorhabdium minutum.</i>
<i>Calamaria joloensis.</i>	<i>Typhlogeophis ater.</i>

The following rare or little-known species are discussed:

<i>Rana everetti</i> Boulenger.	<i>Typhlops suluensis</i> Taylor.
<i>Megalophrys hasselti</i> (Tschudi).	<i>Haplonodon philippinensis</i> Griffin.
<i>Ptychozoon intermedia</i> Taylor.	<i>Hologerrhum philippinum</i> Günther.
<i>Draco mindanensis</i> Stejneger.	<i>Calamaria grayi</i> Günther.
<i>Typhlops cumingii</i> (Gray).	

*Rana merrilli* sp. nov.

*Type*.—No. F876, E. H. Taylor collection; collected at Burdeos, Polillo Island, July 27, 1920, by E. H. Taylor.

*Description of type*.—Choanæ large, very widely separated, partially hidden by overhanging jaw; vomerine teeth in two small oval groups, lying between the choanæ and barely extending back as far as posterior edge of choanæ, separated from choanæ by a distance nearly as great as that between the two groups; tongue large, deeply bifurcated, the horns rounded at their tips; head much flattened; snout moderately

long, extending beyond lower lip; distance of nostril from eye double its distance from tip of snout; distance between nostrils less than interorbital distance, which is distinctly greater than width of upper eyelid; diameter of eye about equal to its distance from nostril; tympanum very large and distinct, its diameter about four-fifths of eye and equal to the interorbital distance; loreal region slightly concave, perpendicular for some distance, then sloping abruptly to lip; canthus rostralis moderately distinct, rather rounded on edge; angle of mouth with a short glandular fold extending to behind tympanum, and another short fold above insertion of arm; distinct narrow dorsolateral folds begin behind eyes and continue dorsolaterally to end of body, converging slightly; upper eyelid without tubercles; skin finely shagreened above; chin, throat, and breast entirely smooth; belly and underside of femur distinctly granulate; below anus two strong elongate glandular tubercles narrowly separated; three outer fingers with strongly widened, rounding disks on tips; inner with small, scarcely widened disks; first finger much shorter than second which is only slightly shorter than fourth; subarticular tubercles strongly developed; three strong carpal tubercles, with a few smaller tubercles scattered over palm; toes with smaller, rather pointed disks; the web between toes extends to base of disks on outer side of first, second, and third toes and on inner side of fifth toe, on inner side of second and third toes to near the disk by a very narrow margin, and to the penultimate joint of fourth; subarticular tubercles moderately distinct; a small inner metatarsal tubercle and a still smaller outer tubercle; hind limb brought forward the tibiotarsal articulation reaches between eye and nostril.

*Color in life.*—Above uniform olive green to lighter green on sides. No spots or markings; no bars on limbs; upper part of loreal region darker olive; a black spot immediately in front of tympanum below eye and another behind tympanum; a small yellow area behind eye and another covering angle of mouth; below greenish yellow to cream with olive spots; dorsolateral glandular folds lighter than body and a slightly darker olive line below them.

*Variation.*—The cotype, from the same immediate locality, agrees in detail with the type save that the tympanum is somewhat larger proportionately and the belly immaculate. I find no vocal sacs in either specimen. The specimens are probably females.



Measurements of *Rana merrilli* sp. nov.

	No. F876, type.	No. F876A, cotype.
	mm.	mm.
Snout to vent.....	33.5	39.0
Width of head.....	11.0	12.2
Length of head.....	14.0	16.0
Depth of snout in front of eye.....	3.0	3.5
Depth of head, at tympanum.....	4.0	5.0
Length of snout.....	5.5	6.0
Eye to nostril.....	4.8	4.5
Diameter of eye.....	4.4	4.8
Diameter of tympanum.....	3.8	4.0
Forelimb.....	22.0	26.0
Width of disk.....	2.0	2.0
Longest finger.....	12.0	13.2
Hind limb.....	60.0	64.0
Femur.....	18.0	19.0
Tibia.....	20.0	22.0
Longest toe, to metatarsal tubercle.....	16.5	17.0

*Remarks.*—This species is differentiated from other Philippine species of *Rana* by the very much-flattened head, the very large tympanum, and the presence of the two transverse glandular folds, or tubercles, below the anus. Specimens were discovered seated on the leaves of *Pandanus* trees which extended over a pool of water in an old stream bed. Two other specimens observed, one in the forest, the other in the same locality, escaped. The species is named for my esteemed friend Elmer D. Merrill, director and botanist of the Bureau of Science, Manila.

*Rana everetti* Boulenger.

*Rana everetti* BOULENGER, Cat. Batr. Sal. Brit. Mus. ed. 2 (1882) 72, pl. 6; TAYLOR, Amphibians and Turtles of the Philippine Islands (1921) 63, pl. 6, figs. 1, 1a, 1b.

A large specimen of this rare species was taken at Pasananka, near Zamboanga. It was found in a rain pool near the small park and water reservoir. The specimen agrees in detail with Boulenger's admirable figure and description. The dorsolateral glandular fold is dim, but it can be traced for two-thirds the length of the body. While not mentioned in the description, Boulenger's figure shows a tubercle between the shoulders slightly to the right of the median line. My specimen has a well-developed, conspicuous tubercle in the same place. The specimen is probably a female and consequently without vocal sacs.

*Measurements of Rana everetti Boulenger.*

	mm.
Snout to vent	80.0
Length of head, to angle of jaw	32.0
Width of head, at tympanum	26.0
Diameter of eye	9.1
Diameter of tympanum	7.0
Eye to end of snout	13.0
Eye to nostril	8.0
Upper eyelid	7.5
Interorbital distance	7.5
Forelimb	44.0
Longest finger with hand	25.0
Hind limb	140.0
Femur	42.0
Tibia	46.0
Longest toe, to metatarsal tubercle	35.0
Widest disk on forefoot	4.5

*Remarks.*—The webbing on the foot reaches the disks by a very narrow margin on the inner side of the second and third toes, and does not extend beyond the outer subarticular tubercle of the fourth. The species appears to be rare, since only this single specimen was found in the course of one month's intensive collecting.

*Philautus williamsi* sp. nov.

*Type.*—No. 356, E. H. Taylor collection; collected on Polillo Island, August 12, 1920, by E. H. Taylor.

*Description of type.*—Choanæ moderately large, widely separated, not concealed by overhanging jaw; vomerine teeth wanting; tongue moderate with two broad rounded horns posteriorly, separated narrowly at base; no tubercle present; head very broad, nearly equal to one-half the length of body; eye large, the diameter of orbit equal to the length of snout; the width of upper eyelid equal to interorbital distance; snout short, ending in a very small conical projection; area about nostrils slightly raised and projecting with a depression between them; upper part of loreal region nearly perpendicular, lower part sloping obliquely to mouth; a distinct depression in front of eye not extending to nostril; tympanum small, indistinct, covered with skin, its diameter about equal to one-third that of eye; a strong fold from eye across upper part of tympanum to insertion of arm; a slight curved fold crossing angle of mouth; skin of body minutely corrugated; head with scattered tubercles, one or two tubercles on upper eyelid, two tubercles behind the eyes, the posterior largest with another pair of dim tubercles in middle

of back; these tubercles connected with the anterior pair by a very dim fold; tibia with indistinct tubercles; skin of throat slightly corrugated; belly, breast, underside of forearm, and femur strongly granulate; fingers with widened disks, the two outer much larger; those of the two inner fingers small, and partially opposed to the other two; subarticular tubercles large, rounded, well defined; carpal tubercles ill defined; toes with pads slightly smaller than those on fingers, one-third to one-half webbed; subarticular tubercles moderately distinct; a wavy skin fold on outer side of fifth toe and part of foot; inner metatarsal tubercle distinct, large, flattened; outer, if present, very indistinct; the tibiotarsal articulation brought forward reaches just beyond tip of snout.

*Color in life.*—Above yellow-brown with markings of darker brown; upper eyelid black; snout and upper part of loreal region dark brown; two light areas behind eyes; a large regular brown spot beginning on shoulders, forking in the middle of the back, is continued to groin; area between branches only slightly lighter than the branches; one broad brown bar across femur and tibia and another narrow outer one; lower part of tibia and inner part of foot pure white; posterior aspect of femur nearly white with slight marbling of brown; second tubercle behind eyes very dark; edge of upper jaw somewhat lighter than lores, and a dim light cream spot below and somewhat behind eye; throat, breast, belly, underside of arm, fingers, foot, toes, and web between toes strongly powdered with cinnamon brown; two inner fingers immaculate.

*Measurements of the type and the cotype of Philautus williamsi sp. nov.*

	No. 356, type.	No. 357, cotype.
	mm.	mm.
Snout to vent.....	21	22
Length of head.....	9	9.6
Width of head.....	10	10
Depth of head.....	4.5	5
Forelimb.....	12.8	13.5
Longest finger.....	6.8	6.3
Hind limb.....	40	38
Longest toe, to metatarsal tubercle.....	9.6	9.5
Diameter of eye.....	4	4
Length of snout.....	4	4

*Variation.*—There is considerable variation both in markings and in the distribution of tubercles on the head and back of the four cotypes. The prominent black tubercle some



distance behind the eye is present in all the specimens, but the narrow fold behind it is not so evident. Some of the specimens have numerous tubercles between the eyes and on the snout; in others they are largely wanting. Specimen 356 shows no characteristic mark on the back. I find no vocal sacs in any of the specimens.

*Remarks.*—The type and three cotypes were collected in southern Polillo along the trail between Polillo and Bislian at a point near where the trail crosses the low divide. A single specimen was collected by Dr. F. X. Williams in mountains near Mauban, Tayabas, on the eastern coast of Luzon. This specimen is rather different in color and markings, but there are no structural differences save those that may be accounted for by the state of preservation. The species is named for Dr. F. X. Williams, of the Hawaiian Sugar Planters' Association, who collected the Luzon specimen. I believe that this is the first record of a species of *Philautus* for Luzon.

*Philautus basilanensis* sp. nov.

*Type.*—No. 1510, E. H. Taylor collection; collected at Abung-abung, Basilan, October 15, 1920, by E. H. Taylor.

*Description of type.*—Choanæ small, widely separated, not concealed by overhanging jaw; tongue narrow, elongate, nicked behind; a slight, rounded tubercle on anterior part of tongue; openings of vocal sacs small, near angle of mouth; snout moderate, pointed, ending in a blunt conical point; canthus rostralis distinct, slightly rounded; loreal region perpendicular for a short distance, then sloping obliquely to edge of lip; nostrils forming raised prominences on snout, much nearer tip of snout than eye; diameter of eye equal to length of snout; eyes prominent, the upper lids equal to interorbital distance; tympanum small, indistinct, covered with skin, not more than one-third diameter of eye; a straight supratympanic fold from eye to insertion of arm; skin of body and limbs very strongly granular, intermixed with larger tubercles; tubercles on head and shoulders arranged in more or less regular lines crossing eyelid and continuing on shoulders; tubercles on femur and tibia arranged in transverse lines; numerous tubercles on eyelids, one more prominent than the others; skin on belly entirely covered with strong mosaiclike granules; lower jaw with a series of glandular tubercles around edge, with a prominent tubercle at tip of lower jaw; tips of digits of hand strongly dilated, those of the two outer fingers double the width of digit; those of the two inner fingers smaller and somewhat opposed to the two outer; sub-

articular tubercles well defined; sole with fine granules; underside of forearm with two or three enlarged tubercles; no trace of web between fingers; toes with enlarged disks at tips, slightly smaller than those on fingers; toes about one-third webbed; subarticular tubercles prominent; undersurface of foot and digits strongly granular; a prominent inner metatarsal tubercle; outer tubercle, if present, not distinguishable from numerous tubercles on sole of foot, which continue to heel; underside of tibia without granules; the leg being brought forward, the tibiotarsal articulation reaches beyond tip of snout.

*Color in life.*—Above reddish brown, variegated with lighter and darker areas but no distinct markings; tips of larger tubercles yellow; tip of snout lighter brown than body; lores dark; belly white to gray; the two inner fingers bright yellow; edge of upper and lower lips yellow; tubercles on lower jaw yellow; underside of hand yellow to cream, of foot reddish brown.

*Measurements of the type and the cotype of Philautus basilanensis sp. nov.*

	No. 1510, type.	No. 1699A, cotype.
	mm.	mm.
Length, snout to vent.....	21	22
Width of head, at tympanum.....	9	8
Depth of head, at tympanum.....	6.6	6
Length of head, to posterior edge of tympanum.....	9	9
Diameter of eye.....	4	4
Length of snout from eye.....	4	4.1
Forelimb.....	11.5	12
Longest finger.....	6	6
Hind limb.....	38	37
Longest toe, from metatarsal tubercle.....	9.5	9

*Variation.*—Two cotypes, taken in the same immediate locality, vary little in essential characters; the granulation is not so strongly defined in either of the other specimens collected. No. 1699A has two rather strong tubercles between the eyes, which are but dimly suggested in the type. No. 1269B is light lavender-brown. A distinct black area lies between the eyes and involves part of the upper lids. A few scattered black spots are between the shoulders. Two large elongate spots are present on each side of the back. The limbs are strongly barred with reddish brown. This specimen has suffered an injury which has destroyed the side of the head and one forelimb.

*Remarks.*—The species appears to be related to *Philautus woodi* Stejneger, but differs in the size and arrangement of the

tubercles on back and limbs, and the greater extent of webbing between the toes. Numerous other differences are evident on a comparison of the descriptions.

Specimens were captured at night by following in the direction of their shrill chirping cry, which for a long time was believed to come from some species of cricket. They were located with great difficulty, perched on the leaves of low shrubs. A few other voices were heard, but these sounds came from a swamp overgrown with thick jungle through which one dared not venture at night.

*Philautus polillensis* sp. nov.

*Type*.—No. 351, E. H. Taylor collection; collected near the southern end of Polillo Island, July 12, 1920, by E. H. Taylor.

*Description of type*.—Head about as wide as body, pointed; tongue moderately long with two short horns, narrowly separated at base; choanæ small, widely separated; vomerine teeth in two small rows, considerably behind the choanæ, separated from each other by a distance one and a half times the length of one of the groups; tongue with a raised moundlike prominence near anterior part; tip of snout conical; nostrils much nearer tip of snout than eye; diameter of orbit somewhat less than length of snout; a single large conical tubercle on upper eyelid near outer middle edge; pupil horizontal; canthus rostralis distinct; loreal region concave, sloping gently to edge of jaw; tympanum rather indistinct, its diameter one-third to one-fourth of eye; a strong fold above tympanum to near insertion of arm dimly granular; a second fold from a point above and behind tympanum to lower jaw; a row of granules from behind tympanum to arm, parallel to the supratemporal fold; a distinct depression between the two folds; skin above practically smooth, with two small tubercles between shoulders and two pairs on back; a small tubercle on back above anus; a distinct tubercle on tip of jaw; skin of throat and breast smooth, with numerous minute pitlike depressions; belly and underside of femur strongly granular; a strong tubercle at heel; tip of each of the three outer fingers with a strongly dilated pad, nearly twice the width of digit; inner finger very small, slender, without pad; subarticular tubercles large, flat, moderately well defined; a single large carpal tubercle; no trace of web; tips of toes distinctly dilated, not more than one and one-half times the width of digit; fourth toe very long, third and fifth equal, barely reaching third subarticular tubercle from the



disk on fourth toe; inner metatarsal tubercle rather large but ill defined; outer small, dim; leg brought forward, the tibiotarsal articulation reaches about halfway between eye and nostril.

*Color in life.*—Above creamy white to yellow, slightly pigmented with minute dots of cinnamon brown; a bar of cinnamon between eyes and dim spots about the dorsal tubercles; upper eyelids dark gray to blackish; spots on outer digits of all limbs; dim bars on tibia and femur; chin and throat yellow with very sparse peppering of brown; underside of hand and belly immaculate; underside of leg and foot strongly peppered with brown.

*Measurements of the type of Philautus polillensis sp. nov.*

	mm.
Snout to vent	27
Length of head, to angle of jaw	11
Width of head, greatest	10
Diameter of eye °	4
Length of snout	4.5
Forelimb	16.3
Longest finger, from wrist	7
Hind limb	42.5
Tibia	14.2
Longest toe, from metatarsal tubercle	11.2

*Variation.*—There are seven cotypes in the collection, all taken in the same immediate locality. These vary more or less in markings, but the coloration is identical. No. 349 (22.5 millimeters long) strongly resembles the type in markings; the pitlike depressions in the skin of the lower jaw are not evident; the tubercles on the back are dimmer. No. 350 (20 millimeters long) is very sparsely pigmented on the back. It was almost white when taken; the skin on the chin and the throat is slightly granulate; the pigment on the back is arranged in two very dim curving lines beginning behind eye; this marking is suggested in the type. No. 353 (19 millimeters long) is similar to No. 350; the sides are lighter, and the slightly curved markings on the back are present. The pigment is heavier between the shoulders and as far forward as the line between the eyes. The snout and the area below the eye are distinctly lighter; the skin of the throat and the chin is smooth. No. 348 (17 millimeters long) has brown spots about the dorsal tubercles and a deep brown line behind eye to insertion of arm; the snout is very light. Nos. 352 and 354 (each 15 millimeters long) have a hair line from between the eyes to above the anus. No.

355 is almost white above with a fine line from the tip of the snout to above the insertion of the arm.

The distinct spots on the two outer fingers are very characteristic. There is some variation in the folds about the tympanum; some of the specimens show these very dimly. In certain specimens the vomerine teeth begin at the hinder edge of the choanæ.

*Remarks.*—Save for the presence of very distinct groups of vomerine teeth I should regard this species as belonging unquestionably to the genus *Philautus*; as it is, I have referred it to that genus with some hesitancy. However, the presence or absence of vomerine teeth is scarcely a generic distinction since we find them present or absent in the very closely related genus *Polypedates*. The character of the digits places it with *Philautus* rather than with *Polypedates*.

The specimens were discovered concealed under and about the leaves of low-growing plants in southern Polillo. The type locality is on a trail running from the walled town of Polillo to the southeastern point of the island (known as Bislian) at a point where the trail crosses the low divide. These specimens were taken during an hour's collecting in this locality. Intensive collecting for nearly one month on the island failed to reveal the species elsewhere.

*Philautus zamboangensis* sp. nov.

*Type.*—No. 1059, E. H. Taylor collection; collected near Pasananka, Zamboanga, Mindanao, September 26, 1920, by E. H. Taylor.

*Description of type.*—Choanæ large, widely separated, partially concealed by overhanging jaw; no vomerine teeth; tongue rather short, forked behind; the openings of the vocal sacs elongate, nearly half the length of jaw; snout short, truncate; eye large, its diameter equal to or minutely less than its distance from end of snout; the distance between nostrils greater than their distance from eye; tympanum small, distinct, partially covered by the supratympanic fold, about one-third the diameter of eye; upper eyelid only minutely less than interorbital distance; interorbital area with a raised prominence followed by a circular depressed area; a broad, shallow depression covering snout; skin of body smooth above with no trace of granules; no tubercles on eyelids; skin on chin and throat smooth or with fine granulations; belly finely granulate; numerous much-enlarged granules about anus; arm very short, the fingers with well-

developed, rounded pads; no web, or only a very small one, between first and second fingers; second and third fingers one-third webbed, third and fourth nearly one-half webbed; subarticular tubercles strongly developed; several small tubercles on palm; a skin fold on outer side of fourth finger ending in a rounded carpal tubercle; two large tubercles at base of first finger; a broken glandular fold on outer side of forearm; first finger not extending as far as second; foot about two-thirds webbed, the web reaching to near base of disk on the outer side of second and third toes but failing to reach base of penultimate phalanx on fourth; subarticular tubercles well defined; a strong inner metatarsal tubercle on outer side of first toe near base; outer metatarsal tubercle very small; a fold on outer side of fifth toe not continued beyond tubercle; a slight skin fold on heel; hind limb brought forward the tibiotarsal articulation reaches tip of snout.

*Color in life.*—Above grayish white on head and body; a dark cinnamon brown bar between the eyes, and dark cinnamon dots scattered on back and limbs; throat cream; belly lemon; under thighs and in groin deep yellow; spots on posterior part of femur and skin fold on heel cream; lores lighter than snout; a sharply defined cream spot below eye which involves part of lid; a dark area on tympanum, following cream spot; a black area below anus and a blackish line from heel to sole of foot; undersurface of hand yellow, of foot light brown.

*Measurements of Philautus zamboangensis sp. nov.*

	mm.
Snout to vent	28
Width of head, at tympanum	10.5
Length of head, to angle of jaw	10.5
Eye to tip of snout	6
Diameter of eye	4.8
Interorbital distance	4
Tympanum	1.5
Forelimb	16.5
Longest finger, from wrist	9
Hind limb	51
Femur	16
Tibia	16
Longest toe	12

*Remarks.*—This species appears to be related to *Philautus bimaculatus* (Peters) and *P. montanus* Taylor. From the former it differs in having the openings of the vocal sacs elongate slits, nearly half the length of the jaw; in the absence of strong tubercles on the under jaw; in having a shorter arm; the distance



between the nostrils being greater than their distance from eye; the undersurface of foot having subarticular tubercles; and in the lesser extent of webbing on foot. The species agree in the shape of the head and the general conformation of the hand. *Philautus montanus* differs from *P. zamboangensis* in having the first and second fingers in opposition to the third and fourth, instead of the first in opposition to the other three.

The only specimen seen was discovered seated in an unfolding leaf of a low plant on the bank of Tumugao River, above the waterworks' intake near Pasananka, Zamboanga. Shortly after capture the specimen became a deep orange color.

*Cornufer cornutus* sp. nov.

*Type*.—No. 764, E. H. Taylor collection; collected at Balbalan, Kalinga, Mountain Province, Luzon, April 24, 1920, by E. H. Taylor.

*Description of type*.—Vomerine teeth in two small, more or less rounded series lying behind the inner edge of choanæ, widely separated from each other; choanæ small, not concealed by jaw; tongue nicked behind, with a distinct papilla on anterior part; snout rather pointed in front of nostrils; canthus rostralis distinct, the lores concave, then sloping obliquely to lip; snout somewhat constricted behind nostrils; nostril a little nearer tip of snout than eye; interorbital distance distinctly wider than upper eyelid, slightly less than distance between nostrils; upper eyelid with numerous, large, rounded tubercles and a well-developed, sharp-pointed dermal spine 1 millimeter long, which projects outward in life; eye small, equal to or slightly longer than its distance from nostril; tympanum small, about two-fifths of eye; a strong supratemporal fold from behind eye to insertion of arm slightly overhanging tympanum; a tubercular fold below eye immediately in front of tympanum and a fold crossing angle of jaws; a few scattered tubercles behind eye; skin generally smooth or finely shagreened, with dim indications of tubercles on back, limbs, and sides; skin on chin and throat smooth; posterior part of belly and underside of femur strongly granulate; fingers with strongly dilated disks, first finger very small, the tip scarcely dilated; fourth finger longer than second; subarticular tubercles large, distinct; small tubercles on palm, and large carpal tubercles; tips of toes dilated but much less so than fingers; a very strong outer metatarsal tubercle, and a dim elongate inner one; hind limb being brought forward the tibiotarsal articulation reaches eye or slightly beyond.

*Color in life.*—Blackish brown above with two putty-colored lines on side of back; small, scattered, greenish spots on back; spots on tympanum, loreal region, and top of head putty-colored; groin yellow; sides of body slightly yellow; upper part of femur yellowish green; throat and belly whitish; femur and tibia greenish yellow below. When preserved in alcohol the greenish spots appear black. The spots on the tympanum, below the canthus rostralis, and on the upper lip are strongly pronounced.

*Measurements of Cornufer cornutus sp. nov.*

	mm.
Snout to vent	31.6
Length of head, to behind tympanum	11
Width of head, at tympanum	12
Depth of head	5
Forelimb	20
Longest finger, to wrist	10.2
Hind limb	49
Longest toe, to metatarsal tubercle	15
Diameter of eye	3.8
Eye to tip of snout	6.2

*Remarks.*—The type was collected from a bush growing in the small stream which furnishes drinking water to the town of Balbalan. It was found seated on a broad leaf directly above the water. Only a single specimen of this new species of *Cornufer* was found in ten days' collecting at Balbalan. This species, more than any other of the numerous species of the genus, is worthy of the name "horn-bearer." The peculiar spine above the eye easily differentiates it from other known species of *Cornufer* in the Philippines.

*Kaloula rigida sp. nov.*

*Type.*—No. 7681, E. H. Taylor collection; collected at Balbalan, Kalinga, Mountain Province, Luzon, April 26, 1920, by E. H. Taylor.

*Description of type.*—(Adult female.) Choanæ large, partially concealed by overhanging jaw, separated from one another by a distance equal to diameter of choanæ; two strong, transverse, palatal ridges immediately behind choanæ, very narrowly separated medially; in front of œsophagus a wide, dermal, transverse, palatal ridge, which is preceded by a second arched ridge; tongue broadly oval, entire; snout short, truncate; rounded on edge; loreal region nearly perpendicular; diameter of eye longer than its distance from end of snout; nostrils as far forward as tip of snout, which slopes backward and down-

ward to mouth; tympanum small, dimly outlined, covered with skin; a distinct fold from behind eye to insertion of arm; a dim fold in front of tympanum and another short fold behind angle of jaw; skin above uniformly corrugated save on tip of snout and lores; belly more or less smooth; a dim suggestion of granulation on throat and chin and on inferior and posterior aspects of femur; tips of digits on hand slightly swollen, no wider than digits; subarticular tubercles moderately developed, large, rather flattened; carpal tubercles not prominent; toes without disks; subarticular tubercles on foot large, flattened, not strongly differentiated; a round, outer metatarsal tubercle and an elongate, blunt-edged, inner tubercle; a small but distinct web between toes; leg brought forward the tibiotarsal articulation does not reach beyond insertion of arm; femur involved in body skin for more than half its length; males with internal vocal sacs.

*Color in life.*—Above deep lavender to purple, slightly iridescent; lighter lavender to brownish in groins and above limbs; dim traces of spots on limbs and a darker triangular area about anus; belly dirty light brown, mottled and reticulated with lighter color; chin and throat dark with fine reticulations of dirty white.

*Measurements of the type of Kaloula rigida sp. nov.*

	mm.
Length, snout to vent	47
Length of head, to behind tympanum	11
Width of head posterior to edge of eye	15
Distance between posterior corners of eyes	11
Depth of head posterior to eye	7.5
Length of forelimb	30
Longest finger	14
Length of hind limb	60
Length of longest toe, to outer metatarsal tubercle	19

*Variation.*—Twenty-two specimens of this species were taken breeding in rain pools in the town of Balbalan, from April 28 to April 30, 1920. Most of the specimens are identical in most details with the type; a few vary in color and markings and in the condition of the skin. The females are distended with eggs, and when alive they were almost triangular in shape. Most of the specimens are colored like the type. One female (No. 838A) is light lavender-brown above with purplish black markings on the back, arranged roughly in the shape of a human being with limbs outstretched; there are two well-defined dark spots above the anus, and the limbs are distinctly spotted; the lores and the



side of the head and body are of a uniform purplish color. The anterior aspect of the femur is also dark.

Several specimens, representing a variation of this species, were taken from under stones in the garden of the Hotel Pines, Baguio, on April 12, 1920. They differ markedly from the type in having the skin very smooth and shiny. The marking on the back is similar to that of specimen 838A but with numerous, rounded, black spots scattered over the back and the sides. When first disturbed the specimens lay flat, stretched their legs out behind, and remained rigid. They were picked up in this condition and remained motionless for a considerable time. One large female, with her body much distended with eggs, has the femur involved in the body skin more than two-thirds of its length.

One specimen (No. 7680, taken at Bontoc, April 20, 1920) was bright brown-red, the skin as smooth and shiny as patent leather. There are a few rounded black spots on the back. The specimen was found burrowed about 10 centimeters deep in loose earth.

This species is related to *Kaloula picta* Duméril and Bibron, but differs in the shape of the head and the body, the size and prominence of the metatarsal tubercles, and the shorter inner toe. Numerous other differences are evident on a comparison of specimens.

*Kaloula kalingensis* sp. nov.

*Type*.—No. 824, E. H. Taylor collection; collected at Balbalan, Kalinga, Mountain Province, Luzon, April 28, 1920, by E. H. Taylor.

*Description of type*.—(Adult female, containing eggs.) Palatal ridges behind choanæ not strongly developed, not meeting medially; choanæ small, not concealed by overhanging jaw; two denticulated ridges across palate in front of œsophagus, the posterior straight, the anterior distinctly arched; tongue oblong, entire, free behind; snout short, truncate, angular in outline from above, extending very slightly beyond lower jaw; nostrils lateral, not or scarcely visible from above, profile at the extremity of snout; distance of nostril from eye greater than its distance to edge of mouth; canthus rostralis rounded; loreal region perpendicular; eye large, length of orbit greater than length of snout; lower eyelid with an opaque, cream-colored area; interorbital distance one and one-half times the width of upper eyelid; tympanum distinct, about three-fifths of eye; a dim skin fold begins behind eye and becomes heavier

behind tympanum; it continues above arm, where it becomes thickened and glandular; a strong fold behind angle of mouth below and behind tympanum, continuing across throat; a deep groove, beginning behind tympanum and continuing to behind insertion of arm, separates the folds; skin above with flattened pustular tubercles prominent on snout, lores, sides, back, and limbs; skin on chin with small granulations; skin on chest smooth, on belly and femur strongly granular; fingers strongly dilated at tips into angular pads more than twice the width of the fingers; anterior edges of pads straight or slightly concave, sides nearly parallel; first finger reaches base of pad on second; second and fourth toes equal, reaching base of pad on third; subarticular tubercles strong, two on third and fourth toes; three distinct carpal tubercles; toes with small, slightly truncate or rounded pads, not or scarcely wider than toes; a strong, oval, inner metatarsal tubercle and a smaller, rounded outer one; subarticular tubercles strongly developed; a single tubercle under first and second toes; two under each of the other three; toes with no or only a very slight rudiment of web; the leg brought forward the tibiotarsal articulation fails to reach tympanum by a distance equal to diameter of tympanum.

*Color in life*.—Bluish black above with deep red markings on neck, sides, and limbs; minute cream markings on each side of anus; belly and underside of limbs mottled with creamy white; tubercles under digits white; throat and chin blue-black.

*Measurements of the type and the cotype of Kaloula kalingensis sp. nov.*

	No. 824 ♀, type.	No. 856 ♂, cotype.
	mm.	mm.
Snout to vent.....	36.5	34.0
Length of head.....	9.5	9.5
Width of head.....	13.5	11.0
Diameter of eye.....	4.8	4.4
Length of snout.....	4.0	3.9
Width of body, greatest.....	18.5	16.0
Longest finger.....	11.5	10.2
Forelimb.....	23.0	22.0
Hind limb.....	46.0	44.0
Tibia.....	15.0	13.0
Longest toe.....	15.5	13.8

*Variation*.—A second specimen agrees with the type in practically all details. It is slightly smaller, as shown in the table of measurements. The tympanum is less distinct and the de-

velopment of the post-temporal folds is not so marked, nor is the groove so pronounced. The specimen is a male and has a subgular vocal sac.

*Remarks.*—The two specimens listed above were taken in rotting logs. They were located by their loud raucous call, which differs distinctly from the call of *Kaloula rigida* sp. nov., found breeding in the same immediate locality. The two species are known to the Kalinga people by the name *gá-ko*. This species seems to be related to *Kaloula baleata* (Müller). From the description and drawing of that species given by Boulenger it differs particularly in the shape of the fingers pads, the length of the third finger, the presence of tubercles on the palm, the number of subarticular tubercles under third finger and fourth toe, and in the distinctness and size of the tympanum. I have remarked<sup>3</sup> that Meyer's specimens of *Kaloula baleata* are the only ones so far reported from the Philippines; there is a chance that an exchange of labels occurred, since Meyer collected the same species in Celebes. The Philippine specimens purport to come from Laguna de Bay.

*Kaloula negrosensis* sp. nov.

*Type.*—No. 538, E. H. Taylor collection; collected at Hinigaran, Negros, in April, 1915, by E. H. Taylor.

*Description.*—Palatine bones forming straight ridges behind choanæ, the ridges widened medially and very narrowly separated; choanæ very large, separated from each other by a distance equal to less than twice the diameter of one, the outer edges somewhat hidden by the overhanging jaw; a strongly defined denticulate dermal ridge across palate in front of oesophagus; a second ridge only dimly defined; snout short, truncate, nostrils near anterior end; canthus rostralis rounded, loreal region slightly concave; eye as long as its distance from end of snout; a strong fold begins behind eye and runs in a straight diagonal line across the dimly defined tympanum to in front of insertion of arm; a fold below tympanum behind angle of mouth, separated from tympanic fold by a distinct groove; skin above on body with distinct tubercles, practically absent laterally; skin on throat, breast, and greater part of belly smooth, somewhat granular on posterior part of belly, on femur, and about anus. Fingers dilated into distinct, truncate disks, nearly a

<sup>3</sup> Amphibians and Turtles of the Philippine Islands, Bureau of Science publication 15 (1921) 194.



half wider than digits; first finger short, not reaching pad of second; fourth finger longer than second, reaching the last sub-articular tubercle on third; subarticular tubercles large, not clearly differentiated; three carpal tubercles very distinct; tips of toes not or but slightly widened; a strong inner metatarsal tubercle nearly the length of first toe, and a small outer one; subarticular tubercles well defined, two on each of the outer three toes; toes nearly one-third webbed. Tibiotarsal articulation reaches tympanum when adpressed.

*Color in life.*—Brownish with very indistinct darker markings above; rather brownish below.

*Measurements of the type and the cotype of Kaloula negrosensis* sp. nov.

	No. 538, type.	No. 538A, cotype.
	mm.	mm.
Snout to vent.....	30.0	29.5
Length of head.....	8.5	8.5
Width of head.....	11.0	10.0
Diameter of eye.....	3.6	3.5
Length of snout.....	3.5	3.5
Width of body, greatest.....	17.0	13.0
Forelimb.....	20.0	19.0
Longest finger.....	8.2	8.0
Hind limb.....	39.5	39.5
Tibia.....	13.0	12.6
Longest toe, to metatarsal tubercle.....	12.5	11.5

*Variation.*—The cotype, also from Negros, shows slight variation; the body and head are slenderer. The fourth toe on the right foot is abnormal, being no longer than the third but much broader and with a wider pad at the tip; the markings on this specimen are distinct. There is a large brown spot on the anterior part of the back with two narrow branches to each eye; two short, truncate, lateral branches above arms and two short posterior branches. Two equal-sized spots are separated from the ends of the posterior branches of the dorsal marking and there is another pair of spots in front of the anus. A distinct bar crosses femur, tibia, and foot, apparently continuous when the leg is folded. There is a dark brown area in the loreal region and another brown area laterally, beginning behind the tympanic fold. The belly is uniform light olive brown.

*Remarks.*—The specimens were taken moving about at night in the street. Only these two specimens were found in my two

years' residence in Negros. The specimens were mentioned in my former publications on Philippine Amphibia.<sup>4</sup>

A further comparative study of the material has convinced me that it represents a species distinct from *K. conjuncta*. It differs from *Kaloula kalingensis* in the different length of the toes, the much narrower pads and their shape, in markings and coloration, and in the amount of webbing. The foot is distinctly broader in *K. negrosensis*.

*Bufo mcgregori* sp. nov.

*Type*.—No. 1468A, E. H. Taylor collection; collected near Pasananka, Zamboanga, September 30, 1920, by E. H. Taylor.

*Description of type*.—(Adult male.) Choanæ small, nearly hidden under the overhanging jaw; tongue elongate, oval, free behind; openings of vocal sacs elongate slits; snout bluntly conical when viewed from above, extending beyond lower jaw and sloping obliquely downward; a distinct keel from tip of snout to mouth; canthus rostralis distinct, loreal region nearly perpendicular, with a depression behind nostril; median area on snout with a broad shallow groove; two slight, rounded ridges on the interorbital area; eye large, prominent, much longer than its distance from end of snout; no evidence of tympanum; a strong constriction a short distance behind eye, separating head from body, represented dorsally by two distinct depressions in front of shoulders; depressions surrounded by glandular skin; snout, eyelid, temporal area, and back very strongly tubercular; upper lip rather glandular; sides and limbs strongly tubercular; belly and throat very strongly granular; fingers long, well developed, the first shorter than second; finger tips swollen, not or very slightly wider than digit; subarticular tubercles dim; two large carpal tubercles; tips of toes swollen into small pads, not widened; the web extends to pads on all but fourth toe, where it reaches to base of last joint; subarticular tubercles dim; three metatarsal tubercles, a prominent, rounded, outer tubercle, and two flattened, inner tubercles subequal in size; the membrane on outer side of first toe continues on inner side of leg; leg brought forward tibiotarsal articulation reaches to anterior corner of eye.

*Color in life*.—Above deep olive, variegated with lighter and darker areas; throat blackish; belly muddy, underside of femur dirty white; scattered, minute, cream-colored spots on belly.

<sup>4</sup> Philip. Journ. Sci. 16 (1920) 327; Amphibians and Turtles of the Philippine Islands, Bureau of Science publication 15 (1921) 194.

*Measurements of Bufo mcgregori sp. nov.*

	mm.
Snout to vent	37
Width of head	12
Length of head	13
Length of snout	4.5
Length of eye	5.2
Interorbital area	4.3
Upper eyelid	3.5
Forelimb	26
Longest finger	11.3
Hind limb	57
Longest toe, to metatarsal tubercle	15
Femur	18
Tibia	19

*Variation.*—Practically all the specimens agree in detail with the characters given in the description of the type. The sharp ridge on the end of the snout, the slight ridges between the eyes, the constriction of the neck behind the temporal region, the rounded depression behind, the absence of any indication of tympanum, the groove on the snout, the presence of strong tubercles over the dorsal surface, the presence of three metatarsal tubercles, and the extent of the webbing on the fourth toe are characters strongly evident in every specimen. The largest specimen is 40 millimeters long. The belly is usually pinkish flesh to dirty white, marbled with darker. Certain of the specimens have indications of dark markings on the back and the limbs with light and dark bars.

*Remarks.*—This species is related to *Bufo muelleri* Boulenger, from which it differs in the constriction of the neck, with rounded depressions in the post-temporal region (characters apparently absent in *B. muelleri*); in having the entire upper surface of the body very strongly tubercular (smooth in *B. muelleri*); three instead of two metatarsal tubercles; and a lesser extent of webbing between the toes.

Specimens were found in Tumugao River, Zamboanga, Mindanao, about 1 kilometer above the waterworks' intake. They were discovered clinging to spray-moistened rocks, in midstream. When disturbed they dived into the swift-flowing water and took refuge under stones at the bottom. Sixteen specimens were obtained. Found only in this locality. The species is named for Richard C. McGregor, ornithologist of the Bureau of Science.



*Megalophrys hasselti* (Tschudi).

*Leptobrachium hasselti* TSCHUDI, Class. Batr. (1838) 81.

No. 1597A, E. H. Taylor collection; collected at Abung-abung, Basilan, October 21, 1920, by E. H. Taylor.

*Description*.—Vomerine teeth wanting; choanæ large, not concealed by jaw, separated by a distance equal to distance of nostril from eye; palatal ridges behind choanæ low; tongue with a distinct nick; head large, about as long as broad; snout rounded, not projecting beyond lower jaw; canthus rostralis distinct, not or but slightly rounding; nostril pierced halfway between tip of snout and eye; loreal region very slightly concave, strongly oblique; interorbital space broader than upper eyelid; eyes large, prominent, extending beyond edge of jaw in profile; tympanum feebly distinct, separated from eye by a distance equal to one-half its diameter, slightly more than half the diameter of eye; a strong fold above tympanum to behind angle of jaw above insertion of arm; no trace of dorsolateral folds; skin on head and above eyes distinctly granulate; fingers obtuse, not swollen at tips; first finger equal to or slightly longer than second; third twice as long as second; subarticular tubercles irregularly elongate, sometimes coalescing into elongate ridges; two strongly defined carpal tubercles, the inner larger than the outer; toes obtuse at tips, not enlarged; subarticular tubercles irregular or forming ridges, usually distinct under longest toe; a very slight web, scarcely discernible, at base of toes; inner metatarsal tubercle moderately prominent, oval; no outer tubercle; tibiotarsal articulation reaches to near angle of jaw; foot slightly longer than head; skin on sides of body granular, with series of larger tubercles; chin and throat granular; belly smooth; underside of femur slightly granular; two strongly developed, large, flat tubercles, or glands, on breast near insertion of arm.

*Color in life*.—Dark purple above with no trace of spots; the granules above slightly lighter; sides of belly with each granule cream yellow, the larger tubercles surrounded by dim black rings; underside of throat dull purplish, mottled with small dots of cream; middle of belly dirty yellow, unspotted; tubercles at base of arm yellow.

*Variation*.—A second specimen obtained in the same locality (No. 1597) agrees in practically all details save that distinct, islandlike markings of black or dark purple are evident on the back, as are spots on the lips and snout.

*Measurements of Megalophrys hasselti (Tschudi).*

	No. 1597A.	No. 1597.
	<i>mm.</i>	<i>mm.</i>
Snout to vent.....	55.0	50.5
Length of head, to jaw angle.....	25.0 <sup>a</sup>	23.0
Width of head.....	23.0	22.5
Length of snout.....	10.5	9.5
Diameter of eye.....	8.0	7.5
Interorbital width.....	5.5	7.0
Diameter of tympanum.....	4.2	4.7
Eye to tympanum.....	3.5	3.0
Forelimb.....	38.5	34.2
Hand.....	12.5	12.0
Hind limb, from vent.....	58.0	60.0
Femur.....	21.0	20.5
Tibia.....	19.0	18.5
Tibia, to tip of longest toe.....	26.0	25.0

*Remarks.*—These specimens agree fairly well with the published descriptions of *Megalophrys hasselti* (Tschudi). The two specimens are males; both have internal vocal sacs, the openings of which are far back and concealed by skin fold.

The call of the species sounds like nothing so much as the harsh raucous squawk of a chicken. The calls were heard while collecting in dense forest at night. Efforts to find them at night were fruitless. The spot was visited by daylight and after sweeping leaves from over a considerable area the two specimens were found.

This is the first record of this species for any Philippine locality save Palawan. I suspect that it also occurs in Mindanao.

*Gekko porosus* sp. nov.

*Type.*—No.—, E. H. Taylor collection; collected on Itbayat Island, Batan Islands (between Luzon and Formosa), November 21, 1921, by G. F. Lopez.

*Description of species.*—Snout moderately pointed; rostral, bent back over snout, borders nostril; posterior part depressed medially, but raised in front of nostrils; two short sutures enter rostral posteriorly in the depressed area; two large internasals border rostral, separated by a single small scale; two distinctly enlarged postnasal scales border nostril; a narrow depression between nostrils, continuing backward on forehead where it widens; two or three rows of somewhat enlarged scales beginning at internasals and following along the elevated borders of the depression, a group of somewhat enlarged scales in front of eyes, not joined with the other series;

granules on supraocular regions larger than those on interorbital or occipital areas; twelve upper labials, last one or two very small; ten lower labials; mental large, distinctly triangular, bordered behind by two large, elongate chin shields at least twice as long as wide; chin shields distinctly pointed in front and truncate behind, in contact with anterior lower labial for more than half their length and forming a mutual suture equal to nearly four-fifths their length; an enlarged scale separates the chin shields from second labial; two or three other enlarged scales bordering chin shields; granules on chin and throat uniform in size; body above covered by minute granules intermixed with small, rounded tubercles arranged in sixteen irregular rows; only a faint suggestion of a skin fold limits the abdominal region; forty-two rows of cycloid imbricating scales on abdomen; tubercles on upper surface of legs; two rows of tubercles continue on tail for about one-third of its length; tail with annulations distinctly marked on anterior part by straight, regular, transverse rows of scales; twelve or more irregular transverse rows to each annulation; tail below with widened scales of practically uniform length and width; scales in the swollen area behind anus distinctly enlarged; occipital region with an irregularly edged, depressed area; a slight prominence above auricular opening; digits widened with undivided transverse lamellæ below, fifteen under fourth toe of each foot; adpressed hind leg reaches beyond elbow of adpressed foreleg; scales preceding vent slightly enlarged, growing somewhat smaller immediately in front of pore scales; a very long series of preanal and femoral pore scales meeting medially in a broad angle; femoral pore scales continue to near end of femur, each scale with a distinct circular depression; eighty scales, forty on each side; ear opening irregularly oval, its diameter about one-third of eye.

*Measurements of the type of Gekko porosus sp. nov.*

	mm.
Total length	111
Snout to vent	50
Tail	61
Snout to foreleg	22
Snout to eye	7
Axilla to groin	21
Foreleg	17
Hind leg	22
Diameter of eye	5
Length of head	16.5
Width of head	10



*Color (in alcohol, freshly preserved).—*Above gray, with darker transverse blotches, somewhat darker on the sides of the neck; no stripes or markings on the head; tail distinctly barred with dirty white on the latter third, dimmer on the median third, and very indistinct or wanting on the basal third; limbs mottled with darker gray, apparently without bands; below dirty flesh white; lamellæ under toes dark; no labial markings.

*Remarks.*—The specimen was obtained from Batan Islands by Gregorio Lopez, who accompanied a relief expedition sent to the Batanes by the Government of the Philippine Islands. He stated that the specimen was caught in a house by a resident of Itbayat Island.

The species is related in a general way to *Gekko japonicus* Duméril and Bibron and to *G. swinhonis* Günther. It differs from *G. japonicus* in the larger number of tubercles on the back, the scalation of the forehead, the very much larger number of pore scales (which very probably represent the number of preanal and femoral pores in the males), and in the markings; *G. swinhonis* differs from the species here described in having no tubercles on the back and fewer preanal and femoral pore scales. From *G. smaragdinus*, a new species described in this paper, *G. porosus* differs in color and markings and in the shape of the body, as well as in scalation and the number and arrangement of the pore scales.

*Gekko smaragdinus* sp. nov.

*Type.*—No. 260, E. H. Taylor collection; collected on Polillo Island, July 12, 1920, by E. H. Taylor.

*Description of type.*—(Adult male.) Rostral large, bent backward over snout, depressed medially but raised in front of nostril, bordering nostril; a slight suture enters rostral medially above; nostril surrounded by rostral, first labial, a supranasal, and two postnasals; an enlarged scale in contact with postnasals but not entering nostril; scales on snout equal, larger than those on occiput; upper labials larger anteriorly, becoming very small near angle of mouth, seventeen on right side, eighteen on left; the row of scales immediately above upper labials distinctly enlarged; lower labials fourteen and fifteen; mental small, rectangular; the rows of scales bordering lower labials somewhat enlarged, the two largest separated from mental by three scale rows; behind these, some distance on each side, is a row of four larger scales separated from labials by one scale row; body above covered with minute, equal-sized

Measurements and scale counts of *Gekko smaragdinus* sp. nov.

No.	Sex.	Length.	Snout to vent.	Tail.	Axilla to groin.	Foreleg.	Hind leg.	Head width.	Head length.	Labials.		Scales between intersals.	Prenatal pores or scales.	Snout to eye.	Eye to ear.	Wide lamellae under long toe.
										Upper.	Lower.					
260	♂	121	59	62	23	16.5	24	11.2	16	15-18	14	3	20-20	6	5.1	19-18
263	♂	124	61.5	62.5	30	17.5	25	10.5	17	14-16	13-15	4	20-20	6	5	21-21
257	♂	114	55.5	58.5	27	17	22.5	9	14.5	18-18	15-15	3	18-19	5.7	4.8	20-21
256	♂	114	55.5	58.5	28.5	17.5	22.1	10	15.5	16-20	15-16	4	23-22	5.8	4.9	20-22
258	♂	119	62	57	31.5	17.5	25	11	17	16-17	15-15	3	20-19	6	5	21-22
255	♀	124.5	58.5	66	32	17	23	10	18	15-16	14-14	3	20-21	6	4.8	19-19
265	♂	120	58	62	30	18	24	9	15	16-17	15-15	4	20-21	6	4.5	19-20
261	♀	120	62	58	33	18	25	10	14.8	16-17	15-15	3	19-20	6.1	4.8	18-19
267B	♂	104	53.5	45.5	30.5	20	24	9.8	15	16-19	16-16	4	21-21	6	5	18-18
265A	♂	118	61	57	30	20.5	25.5	10.5	16	15-17	15-16	3	19-20	6.1	5	19-19
265B	♀	126	63	63	32	17	24	10	17	15-16	14-15	4	19-20	6.2	5	18-18
259	♀	90	61	29	32.2	16.5	28.5	10	15	16-18	14-15	3	21-21	6	4.9	21-21
267	♀	115	58.5	56.5	28	17	22.5	9	14	16-18	15-15	4	23-22	5.5	4.5	19-19
267A	♂	112	55	57	26	15.1	22	9	14	15-16	13-14	3	19-20	6	4.2	18-18
262A	♂	110	55	54	28	17	22	9	14	17-17	15-16	4	21-21	6	4.9	19-18
262	♀	117	58	59	30.1	18	22	10	16	18-19	14-15	4	21-22	6	4.5	19-18
263A	?							10.2	17	18-19	13-15	3		7	4.5	
264	♂	75	55	20	28	18.1	21.5	10	14.5	16-17	13-13	3	19-20	5.6	4.7	17-18
268	♀		54		29	15.5	21	8	14	17-17	13-14	3	19-20	5.2	3.8	18-18
262B	♂	84	55	29	26	17	22	8.2	14	16-18	14-15	3	19-22	6	4.4	18-19
264A	♀	80	50	30	24	17.5	21	8.8	13.5	15-16	13-15	4	22-22	5.8	4	18-18

granules, with no evidence of tubercles; scales on belly larger, imbricate; no evidence of a lateral skin fold; scales on posterior part of chin and throat very small, equal; tail not annulate; preanal and femoral pores continuous, forming an arch medially, seventeen pores on each side; scales anterior and posterior to pore scales only slightly larger than other belly scales; scales directly in front of anus only slightly enlarged; digits flattened through entire length, with a single row of lamellæ below, seventeen under longest digit on foreleg, twenty-one under longest toe; the lamellæ on base of digits broken into from two to four scalelike elements; body extremely elongate and narrow, of equal width throughout entire length; tail tapering gradually, only slightly flattened.

*Color in life.*—Body above clear yellow-green to leaf green, more green on back than on sides and on limbs; side of head yellowish; numerous, rounded, black spots on head and shoulders arranged more or less regularly; a series of dim, uneven, cream spots begins behind the eye and continues halfway along the body on each side; iris of eye golden yellow; distal two-thirds of tail reddish brown, to salmon below, with series of cream yellow spots bordered by black almost circling the tail; belly whitish yellow; underside of limbs very light yellow-green to greenish yellow.

*Measurements of the type of Gekko smaragdinus sp. nov.*

	mm.
Total length	133
Snout to vent	62
Tail	71
Snout to foreleg	24
Axilla to groin	34
Foreleg	19
Hind leg	25
Length of head, to auricular opening	14
Width of head	10
Greatest body width	7
Snout to eye	6.7
Eye to auricular opening	4.8
Diameter of orbit	4
Diameter of auricular opening	1.2

*Variation.*—There are twenty-one cotypes in the collection taken at practically the same time as the type. The variations in measurements are due to the different ages of the specimens. There are fourteen to nineteen upper labials and thirteen to sixteen lower labials. This large difference is due to the degree



of differentiation of the small scales that border the posterior part of the mouth, after the mouth curves upward. There are three or four small scales bordering the rostral behind. There are eighteen to twenty-two lamellæ under the longest toe, the variation being chiefly in the basal count. The arrangement of the preanal and the femoral pores varies in some individuals. In a few of the specimens, the line curves distinctly upward at the beginning of the femoral pores. In others no such curve is evident. There are eighteen to twenty-three pores on each side.

The coloration was practically uniform in the specimens when they were first taken. Some of the specimens have more black spots on the head and the anterior part of the body than others.

*Remarks.*—The species was discovered on a species of large *Caladium*. The specimen took refuge under water which was held in the petiole of a huge leaf. All other specimens were taken from *Pandanus* trees which were growing along small streams. The spiny-leaved trees were cut and allowed to fall in the water. The specimens were finally driven from their hiding places in the leaf axils and forced to swim to land. These spiny *Pandanus* trees were splendid collecting places and harbored, besides the described species, several species of frogs and lizards.

This species belongs to the section of the genus *Gekko* which includes *G. swinhonis* and is characterized by the absence of tubercles on the back. The number and arrangement of the preanal pores and the very distinctive markings easily separate the species. Many differences are evident from a comparison of descriptions. It would appear that the species is very closely associated with the *Pandanus* trees. This association may account for the fact that it has not been collected before.

***Ptychozoon intermedia* Taylor.**

*Ptychozoon intermedia* TAYLOR, Philip. Journ. Sci. § D 10 (1915) 95; Lizards of the Philippine Islands (1922) 101.

A female specimen of *Ptychozoon intermedia* Taylor (No. 1075), taken near Zamboanga, agrees with the type specimen taken in eastern Mindanao, save that there are no rounded tubercles on the back. Each annulation on the tail is marked posteriorly with enlarged spinous tubercles, much as is the type; the granules on the neck and the back are smaller. The scales under the tail are divided into two rows of enlarged scutes, while in the type occasional scales are not divided, and others are divided into more than two parts.

*Measurements of Ptychozoon intermedia* Taylor.

	mm.
Total length	176
Snout to vent	88.5
Length of head	24.5
Depth of head	10
Width of head	19
Axilla to groin	45
Foreleg	28
Hind leg	39
Width of lateral flap	8.5
Length of femur	15
Body width	21
Snout to orbit	11
Length of longest finger	9.5
Length of longest toe	11.5

*Remarks.*—It will be seen that the measurements of the second specimen agree very well with those of the type. This specimen is dark black-brown over the greater part of the body; the deep brown, wavy lines on the back are scarcely distinguishable.

On the tree from which the adult was taken, two eggs were found under bark attached to the tree. The eggs were joined together. The greatest diameter of either egg was 15.5. One egg was opened to verify beyond doubt its identity. The embryo measured 28 millimeters from snout to vent; tail, 26; the narrow flap on the tip of the tail is present as in the adult. The young is very strongly marked in a pattern similar to that in the type.

In southern Basilan certain freshly laid eggs of what appears to be this species were taken in October, 1920, but no adult was seen. In 1917 I found an egg on Buluan, a small island south of Basilan, containing a double-headed embryo of what was undoubtedly this species. I lost the specimen while swimming from shore to my launch across the coral reef.

*Draco mindanensis* Stejneger.

*Draco mindanensis* STEJNEGER, Proc. U. S. Nat. Mus. 33 (1908) 677;  
TAYLOR, Lizards of the Philippine Islands (1922) 128.

The type and cotype of this species were collected by Dr. E. A. Mearns, at the base of Mount Malindang, western Mindanao. Both specimens were males. The two specimens here recorded are from the tip of Zamboanga Peninsula, near Zamboanga, nearly 200 kilometers distant from the type locality. A male and a female were taken, both apparently belonging to Stejneger's species. The sexes vary greatly in color and markings.

*Description of adult female.*—Agrees with Stejneger's description save in the following points: Rostral two and one-half to three times as long as broad, bordered by eight scales; nostril vertical in a raised, truncate, conelike scale, separated from

rostral by two scale rows; a median series of keeled scales with indistinct posterior diverging branches represented by two rows of keeled scales in each branch; occipital region with three differentiated scales, bordered by irregularly shaped, more or less keeled scales; a few large scales in a longitudinal row posterior to orbit; tympanum entirely hidden by small scales; thirteen upper labials (eleven on left side); no trace of nuchal crest; no enlarged or differentiated scales on neck; mental large, roughly triangular, not as long as rostral, but much wider; twelve lower labials; all scales on chin distinctly keeled, those along labials largest; back covered with irregular-sized, keeled scales; a few dorsolateral groups of enlarged scales; gular appendage distinctly developed, the anterior outline curving, the tip bluntly curved; near tip is a small spur about 1 millimeter long, emerging about 1 millimeter from tip; lateral nuchal membranes strongly developed. Otherwise this specimen agrees with the type in scalation.

*Color in life.*—Delicate yellow-green above; large paper white spots on back arranged in transverse lines; chin and underside of head pale greenish yellow; tip of gular appendage cream yellow; chin with cream dots; wings, above, blackish with numerous narrow lines and small dots; below, uniform dusky, without spots.

*Adult male.*—This male specimen agrees more closely with the type than does the female just described. There are fourteen and fifteen upper labials; there is a small nuchal crest. The gular appendage is longer than in the type.

*Color in life.*—Body yellow-olive above, mottled with areas of darker and lighter color, spots on back grayish white, in transverse rows. Wings, above, brown-red to brick red with narrow lines of minute cream dots; below, immaculate brown-red, growing purplish toward the outer, upper part; belly and underpart of limbs flesh color; gular appendage vivid orange yellow.

*Remarks.*—The development of the gular appendage in the female is greater than that in any other *Draco* known in the Philippines. The small spur on the tip appears to be a normal development. The two specimens were shot from trees in heavy forest, in low mountains, at an elevation of approximately 300 meters. No other specimen was seen.



Measurements of *Draco mindanensis* Stejneger.

	No. 1129, ♀.	No. 1130, ♂.
	mm.	mm.
Total length.....	265	205
Snout to vent.....	87	90
Tail.....	178	<sup>a</sup> 115
Width of head.....	14	12
Length of head.....	19	19
Foreleg.....	42	42
Hind leg.....	51	53
Gular appendage.....	9	23
Snout to eye.....	7.5	8

<sup>a</sup> Tip missing.*Sphenomorphus bakeri* sp. nov.

*Type*.—No.—, E. H. Taylor collection; collected at Haight's place, Pauai, Benguet, Mountain Province, Luzon, April, 1921, by Charles Fuller Baker.

*Description of type*.—Rostral large, bent back over snout, forming a curved suture with frontonasal, broadened at base; frontonasal large, barely in contact with anterior loreal, rounded posteriorly, minutely in contact with frontal; prefrontals somewhat triangular, smaller than frontonasal, separated narrowly; frontal large, four-sided, the posterior tip slightly rounded, touching two supraoculars and first superciliary; frontoparietal large, single, broader than long, touching frontal; interparietal large, well developed; parietals about one and one-half times as long as broad, forming a suture behind interparietal; no nuchals; nostrils in center of a moderate-sized nasal scale; nasal in contact with one labial; two loreals, not superimposed, anterior higher and narrower than posterior, its lower tip inserted somewhat between the first two labials; two preoculars, and two small anterior suboculars; eyelid scaled, opaque; six or seven superciliaries; four large supraoculars, last bordered by two smaller scales, separating it from parietal; parietals bordered by three temporals; anterior much the largest; six upper labials, fifth largest, fourth longest; tympanum scaled over and indicated by a depression (unnoticeable when freshly preserved); mental large; five lower labials; one azygous postmental, followed by three pairs of chin shields, only first pair in contact; twenty-eight scale rows around body; two enlarged preanal scales; ten or eleven lamellæ under longest toe.

*Color (in alcohol, freshly preserved).—*Above brown, minutely powdered with darker brown, more pronounced medially, forming an indistinct dorsal line; side of head, neck, and anterior part of body bluish black but the color not solid; sides of tail scarcely darker than above; chin and throat darker, mental, postmental, and chin shields each with a large light spot; belly and underside of tail dirty white; limbs light brown with darker brown areas, and with lighter spots on posterior and anterior aspect of limbs and foot.

*Measurements of Sphenomorphus bakeri sp. nov.*

	mm.
Total length	38.5
Snout to vent	24
Snout to foreleg	7.5
Axilla to groin	11.5
Tail (tip regenerated)	14.5
Foreleg	6.5
Hind leg	7.5

*Remarks.*—This small skink was collected by Charles Fuller Baker on the mountain trail at Pauai, or Haight's place, 58 kilometers north of Baguio. The elevation here is about 2,500 meters. This is the highest elevation recorded in the Philippines for any reptile or batrachian. The species must be rare, as my two days' intensive collecting in this locality during April, 1920, failed to reveal it. This appears to be a diminutive species, similar in size to *Sphenomorphus steerei*, which it resembles in a general way. It may be differentiated from known species of *Sphenomorphus* by the scalation of the tympanum. When freshly preserved, no depression was noted where the tympanum is normally found, but after being removed a short time from the alcohol a depression became evident.

I name the species for its discoverer, Charles Fuller Baker, dean of the College of Agriculture, University of the Philippines, in recognition of his valuable contributions to the entomological knowledge of the Philippines.

*Siaphos herrei sp. nov.*

*Type.*—No. 208, E. H. Taylor collection; collected on Polillo Island, July, 1920, by E. H. Taylor.

*Description of type.*—Rostral large, bending backward over snout, the area visible from above equal to more than half the width of internasal; latter large, broader than long, narrowly in contact with frontal; prefrontals large, narrowly separated medially, forming sutures laterally with two frenals; frontal more than one and a half times as long as broad, diamond-

shaped, with a rounding point behind touching two anterior supraoculars, its width slightly less than that of supraocular region; frontoparietals large, forming a mutual suture twice as long as suture with parietals; interparietal broadly triangular, longer than broad; parietals not nearly twice as long as wide, forming a suture behind interparietal; a large temporal borders parietal, nuchal scales strongly widened, narrowing gradually after third pair; nostril in a single nasal, which is placed diagonally; two frenals, anterior slightly higher than posterior; two preoculars, lower largest, followed by two small scales above labials; four supraoculars, the second widest, anterior and posterior triangular; nine superciliaries; seven upper labials, fifth entering orbit; four enlarged temporals; mental shaped like rostral, but larger; a large postmental bordered by two labials; a pair of enlarged chin shields longer than wide, forming a long suture; these followed by two pairs of divided shields; six lower labials; lower eyelid with a large transparent scale; snout one and a half times as long as length of orbit; auricular opening well defined; tympanum moderately sunk; legs weak, the adpressed legs failing to meet by a considerable distance; legs with five clawed digits; about thirteen lamellæ under each of the two middle fingers; twenty-three lamellæ under longest toe; scales in twenty-two rows around middle of body, the two median rows much widened; two distinctly enlarged preanals.

*Color in life.*—Above light brown, with a dark brown lateral band on each side covering parts of two scale rows; the lower part of sides, belly, and underside of head and tail flesh color.

*Measurements of the type and cotypes of Siaphos herrei sp. nov.*

	No. 208	No. 207.	No. 209.
	mm.	mm.	mm.
Total length .....	92.0	54.0	43.2
Snout to vent .....	41.0	39.0	38.2
Snout to eye .....	2.5	2.6	2.5
Snout to ear .....	7.0	7.0	6.7
Snout to foreleg .....	13.5	13.5	13.5
Axilla to groin .....	22.0	22.0	22.0
Width of head .....	4.5	5.0	4.3
Foreleg .....	8.5	8.0	8.0
Hind leg .....	12.0	12.2	12.0

*Variation.*—The specimens are very similar in most details. No. 207 has the internasal and the left prefrontal partially joined as the result of an injury; a very young specimen, No.



211 (snout to vent, 22 millimeters), has the interparietal enlarged and the posterior supraoculars broken abnormally.

*Remarks.*—This species differs from the other species of the genus in having a divided frontoparietal. In general it agrees most closely with *Siaphos auriculatum* Taylor, of Negros, and *S. kempi* Taylor, of Mindoro. The species is an arboreal one and was found in the root masses of the large bird's-nest fern *Asplenium nidus* and in *Pandanus* trees. The type specimen was captured just outside of the old wall that surrounds the town of Polillo. Six specimens were found.

The species is named for my esteemed friend Dr. Albert C. Herre, chief of the division of fisheries, Bureau of Science, Manila, who has kindly coöperated in making collections.

#### SNAKES

##### *Typhlops suluensis* Taylor.

*Typhlops suluensis* TAYLOR, Philip. Journ. Sci. § D 13 (1918) 257; Snakes of the Philippine Islands (1922) 61, text figs. 1 and 3.

A specimen (No. 1587, E. H. Taylor collection) of this rare species, heretofore known only from the type, was captured on Basilan Island. It was found under the loose bark of a growing forest tree, 2 meters from the ground. The specimen agrees with the type in most details. The following are the measurements and scale counts of the Basilan specimen:

*Measurements and scale counts of Typhlops suluensis* Taylor.

	No. 1587.	Type.
Total length.....mm..	390	340
Tail.....mm..	14	13
Width of tail.....mm..	5.5	5.5
Width of body.....mm..	7.6	7.4
Width of head.....mm..	6.5	5.5
Tail width in tail length.....times..	2.5	2.4
Body width in body length.....do....	51	46
Tail length in body length.....do....	28	26

*Remarks.*—The specimen agrees with the type save that the interparietal is broken into two parts. The median ventral row of scales is clearly differentiated. The underside of the tail is darker than the rest of the underside of the body. The differentiation of the median ventral series of scales of this species distinguishes it from other Philippine species of the genus.

##### *Typhlops cumingii* (Gray).

*Onychophis cumingii* GRAY, Cat. Liz. Brit. Mus. (1845) 133.

*Typhlops cumingii* TAYLOR, Snakes of the Philippine Islands (1922) 66, text fig. 4.

Two specimens of this rare species were collected on Polillo Island in July, 1920. Most of the specimens of these long-tailed species that I have collected have been found in root masses of aërial ferns. Whether or not aërial root masses are the normal habitat of *Typhlops* I cannot say. However, my own experience in collecting has given evidence that such is the case. In Mindanao all but two specimens of the numerous species of *Typhlops* that I found were collected from the root masses of aërial ferns. Accordingly, in Polillo I began a systematic search for the species within the fern roots, sending my assistants into trees to cut the ferns from their resting places, then cutting the tough masses to pieces when they had fallen. From more than one hundred root masses so treated two specimens of *Typhlops cumingii*, three of *Typhlops braminus*, two of *Haplonodon philippinensis*, and a new species of lizard, *Siaphos herrei*, were captured.

*Measurements and scale counts of Typhlops cumingii (Gray).*

	No. 300.	No. 299.
Total length ..... mm	453	373
Tail ..... mm	27	25
Width of body ..... mm	8	7
Width of tail ..... mm	6	5.3
Width of head ..... mm	6.5	5.7
Depth of head ..... mm	4	4
Scales on belly from mouth to vent, approximately ..... mm	480	496
Scales under tail ..... mm	40	39
Scale rows on body ..... mm	26	24
Tail width in tail length ..... times	4.5	4.8
Body width in body length ..... do	56.5	53.2

*Variation.*—The rostral is slightly more than one-half as wide as the head and fails to reach the level of the eye by a very slight distance.

*Dryocalamus mecroryi* sp. nov.

*Type.*—No. 1517, E. H. Taylor collection; collected at Abung-abung, Basilan (on the southern coast), October 23, 1920, by E. H. Taylor.

*Description of type.*—Rostral distinctly broader than high, forming its longest suture with internasals, only slightly visible above; internasals about as wide as long or a little longer, forming their longest sutures with prefrontals, the suture with nasals curved; prefrontals about as long as wide, broadly in contact with loreal and nasal; frontal one and two-thirds times as long as broad, longer than its distance from tip of snout, slightly

wider than the widest part of supraocular; parietals one and two-thirds times as long as wide, forming a suture for about four-fifths their length, truncate behind; nasal large, irregular, partially divided, posterior part largest, much higher than anterior part; an elongate loreal, more than twice as long as wide, entering orbit; one preocular; supraocular much shorter than frontal, much wider posteriorly than anteriorly; two postoculars, upper square, touching parietal, lower higher than upper; two anterior temporals, followed by three, then by four; the last superior temporal much the largest; three temporals bordering parietals; nine upper labials, fourth and fifth entering orbit; mental much broader than deep; two pairs of chin shields, anterior much longer and wider than posterior, five labials touching anterior; ten lower labials, the last lower and upper labial not well differentiated; eye moderate, its diameter nearly equal to its distance from nostril; pupil vertically elliptic; scales in seventeen smooth rows, without apical pits; ventrals, 220, keeled laterally; anal single; subcaudals, 121, in two rows; head distinct from body, flattened; tail very slender.

*Color in life.*—Snout black, growing brown on parietals; a V-shaped white mark bordering the posterior edge of frontal; a black mark begins on posterior edge of parietals and continues on neck; a black mark below eye continues back to eighth labial; lip light, flecked with darker; chin and neck white; anterior part of lower lip flecked with dark; body with fourteen elongate, irregularly edged, black, saddlelike blotches which are narrowed laterally, reaching the edges of the ventrals; these blotches cover twelve scales longitudinally, and are separated by smaller white rings which are four to five scales long medially but cover as many as eight scales laterally, the last two white rings with black spots; tail with nine black blotches which encircle tail toward its end; belly white.

*Measurements of Dryocalamus mceroryi sp. nov.*

	mm.
Total length	350
Snout to vent	258
Tail	92
Width of head	8
Length of head	13
Width of neck	4.5

*Remarks.*—The species here described fails to agree with the generic characters assigned to *Dryocalamus* by Boulenger, as follows: There are seventeen scale rows instead of thirteen to fifteen; no apical pits on the scales; the dentition of the maxillary differs in that there are eleven or twelve teeth, increasing



in size to eighth or ninth, and then one or two smaller teeth, followed by one or two larger. The general arrangement of the dentition resembles that of *Stegonotus* Duméril and Bibron, but the number of teeth is much less. In general configuration, the relation of the loreal and the preocular, and even in markings, the species appears nearest to *Dryocalamus gracilis* Günther. I have not ascertained whether "one or two more or less distinct tooth-like knobs on the basisphenoid" <sup>5</sup> are present or not, as I hesitate to mutilate the type. The specimen was taken lying quietly in sunlight at the base of a stump in the forest, only a few meters from the sea. Only a single specimen was found.

The species is named for Mrs. Ida M. McCrory, of Manila, who has assisted me greatly in making collections.

*Haplonodon philippinensis* Griffin.

*Haplonodon philippinensis* GRIFFIN, Philip. Journ. Sci. § D 5 (1910) 212, text fig. 1, pl. 1; TAYLOR, Snakes of the Philippine Islands (1922) 126, pl. 9, fig. 13.

Two specimens of this rare snake were taken on Polillo Island in July, 1920. They were found in the root masses of the aërial fern *Asplenium nidus*. Two other specimens observed in similar localities escaped. The measurements and scale counts follow:

*Measurements and scale counts of Haplonodon philippinensis Griffin.*

	No. 319.	No. 320.
Length .....	550	333
Snout to vent.....	394	242
Tail.....	156	91
Width of head.....	9	7
Length of head.....	15	11
Ventrals.....	210	209
Subcaudals.....	121	122

*Remarks.*—In general conformation the specimens agree with the type. No. 319 has the loreal broken in two on the right side, leaving two preoculars, and on the left the fifth labial is broken, making a third preocular; the nasal appears to be partially divided. There are 88 spots on the dorsal surface. In No. 320 the loreal is broken on both sides, leaving two preoculars, the loreal not entering the eye. There are 96 spots along the back.

A single specimen has just been received from Itbayat, Batan Islands. It agrees with No. 320 in having the loreal broken

<sup>5</sup> Boulenger, Cat. Snakes Brit. Mus. 1 (1893) 369.

on both sides. The specimen is larger and the head is proportionately broader than in either of the Polillo specimens.

*Hologerrhum philippinum* Günther.

*Hologerrhum philippinum* GÜNTHER, Cat. Col. Snakes (1858) 186;  
TAYLOR, Snakes of the Philippine Islands (1922) 116, pl. 7.

During my past two years' collecting, specimens of this rare snake have been found in four localities: Polillo Island (Nos. 297 and 298); Kalinga, northern Luzon (Nos. F735, F937, F932); Mount Mariveles, Bataan Province, Luzon (Nos. 1781 and 1782); and Mount Maquiling, Laguna Province, Luzon (No. 1873). Eight specimens were taken altogether.

*Measurements and scale counts of Hologerrhum philippinum* Günther.

No.	Sex.	Total length.	Snout to vent.	Tail.	Length of head.	Width of head.	Ventrals.	Subcaudals.
		mm.	mm.	mm.	mm.	mm.		
297.....		324	256	68	14	8	136	47
298.....		178	142	36	9.5	5	138	48
735.....	♀	360	286	74	14	8	151	49
937.....	♀	402	325	77	15	8	151	46
932.....	♀	354	287	67	14	7	154	46
1781.....		305	249	56	13	7.5	150	43
1782.....		274	228	<sup>a</sup> 46	12	7	153	42
1873.....		210	165	45	9	6	146	49

<sup>a</sup> Tip missing.

*Variation.*—The markings agree very well with those given in the drawing of the type; the color varies rather markedly. No. 735, bright reddish to orange brown, darker anteriorly; belly bright reddish salmon, lighter anteriorly; underside of head dusky, with milk-white spots; stripe on side of head cream yellow. The specimen was found crawling in the open along a path. Nos. 1781 and 1782 when taken were reddish brown above, below dirty white, growing pinkish anteriorly. These specimens were taken under rocks in the edge of a small brook. No. 1873 was taken under a log. The cream line on the side of the head has a pink area below it. Dim lines of minute yellow dots are present on each side of the anterior dorsal part of body; belly uniform coral to red. The blackish dots on the outer edge of ventral scales are associated with a small milk-white spot.

*Pseudorhabdium minutum* sp. nov.

*Type.*—No. F772, E. H. Taylor collection; collected at Balaban, Kalinga, Mountain Province, Luzon, April 25, 1920, by E. H. Taylor.

*Description of type.*—Rostral very narrow, small, higher than wide, minutely visible above, not as wide as mental; internasals five-sided, small, about one-third the size of prefrontals, the sutures with nasal and prefrontal equal, forming their shortest sutures with loreal; prefrontals five-sided, entering eye, sutures with frontal and loreal nearly equal; the sutures formed with internasals transversely straight, those with frontal together form a slight angle; frontal broader than long, the anterior edge only very slightly angular, not reaching anterior to eyes; parietals more than twice as long as wide, forming a mutual suture for more than half their length; nostril pierced in a partially divided nasal; postnasal present on right side (fused with loreal on left); loreal large, much elongate, entering eye on right side, failing to do so by a short distance on left side; supraocular small, as long as eye, longer than broad; a small postnasal; five upper labials, third and fourth entering eye, fifth very large, touching parietal; two temporals posterior to fifth labial bordering parietal; a scale directly behind fifth labial might be regarded a sixth labial save that it appears to be behind angle of mouth; mental moderate, touching anterior chin shields, which are nearly three times as long as wide; posterior chin shields about half as long as anterior, forming a mutual suture for less than half their length; five lower labials, three touching anterior chin shields; ventrals, 140; anal single; subcaudals, 15; scales smooth, in fifteen rows, without apical pits.

*Color in life.*—Deep ultramarine with yellow-green to blue iridescence; a spot on the chin cream; ventrals each with a bluish band followed by a lighter area; parietals darker than body; a few yellowish spots in front of anus; underside of tail colored as on back.

*Measurements of Pseudorhabdium minutum sp. nov.*

	mm.
Total length	150
Snout to vent	139
Tail	11
Width of head	5
Length of head, to parietals	6
Width of body	5

*Remarks.*—The species is related to *Pseudorhabdium menamaræ* Taylor but differs in numerous characters. The tail of this new species is proportionately much shorter, with fewer ventrals; the markings and color are different; the frontal is shorter and truncate in front, and the rostral is smaller. It is impossible to tell whether the presence of a postnasal is the



normal condition or not. Only the type was found. It was taken under a small log, in deep forest, immediately behind the town of Balbalan.

*Typhlogeophis ater* sp. nov.

*Type*.—No. 1103, E. H. Taylor collection; collected near Pasananka, Zamboanga, Mindanao, September 28, 1920, by E. H. Taylor.

*Description of type*.—Snout pointed, rostral higher than broad, distinctly visible above; internasals small, about equal to one-fourth the prefrontals, their mutual suture less than one-third the length of that between prefrontals, in contact with second labial; prefrontals large, touching two labials laterally, and ocular scale; no loreal; no preocular; frontal much broader than long, the anterior edge forming a straight transverse line on a level with eyes; frontal about one-half the length of parietals, very broad, in contact with ocular; parietals elongate, nearly twice as long as wide, forming a mutual suture for more than half their length; nostril between first labial, which is fused with the anterior nasal, and a small nasal; five upper labials, third and fourth bordering ocular, which covers eye; the scale has a rounded, transparent prominence on anterior part, through which the eye is distinctly visible; no postocular distinct from ocular; no anterior temporals; one large posterior temporal bordering parietals, with two enlarged scales below it; no supraoculars; mental small, three times as wide as deep; two pairs of chin shields, the anterior about three and one-half times the size of second pair; three labials touching chin shields (four on right side); five lower labials. Ventrals, 113, not keeled or angular; subcaudals, 33; anal single; tail slender, pointed; scales smooth, in 15 rows, without apical pits.

*Measurements of Typhlogeophis ater* sp. nov.

	mm.
Total length	173
Snout to vent	143
Tail	30
Width of head	4.5
Length of head	8
Width of body	4

*Color in life*.—Uniform blackish brown, somewhat iridescent above; belly and region under tail slightly lighter blackish brown; head colored like body.

*Remarks*.—The genus *Typhlogeophis* was created by Günther for *T. brevis* Günther, a species founded on a single specimen collected by A. Everett, supposedly on Mindanao or Dinagat

Island. The species here described differs markedly from *T. brevis*. In *T. ater* there are 40 ventral scales less on the belly and 18 more subcaudals; the frontal is wider than long; the eye is visible through the transparent ocular; there is a striking difference in the relative sizes of the chin shields; the tail is long and slender; the scales and shields are not white-edged. The ocular scale appears as a fusion of two elements, the post-ocular part is distinct, and there is a slight depression between this and the rounded, moundlike, transparent part covering the eye.

My specimen was taken in a small brook that empties into Tumugao River just above the waterworks' intake near Pasananka, Zamboanga. It was found under a partly submerged log in wet earth. It was very active, and escaped over a waterfall. It was found again only after a long, diligent search.

*Calamaria joloensis* sp. nov.

*Type*.—No. 1855, E. H. Taylor collection; collected in central Jolo, October 30, 1920, by E. H. Taylor.

*Description of type*.—Rostral broader than deep, distinctly visible from above; prefrontals large, longer than wide, forming lateral sutures with nasal, two labials, and preocular; frontal six-sided, very pointed behind, large, distinctly longer than its distance from end of snout, longer than wide, at least three and one-half times the width of supraocular; parietals large, forming a mutual suture for little more than half their length; nasal extremely small, triangular; one small preocular; supraocular not quite twice as long as wide; one small postocular; no anterior temporals; diameter of eye slightly less than its distance from mouth; five upper labials, third and fourth entering eye, fifth very large, forming a long suture with parietals; a single posterior temporal; two scales following parietals distinctly enlarged; mental small, in contact with chin shields; four lower labials; chin shields partially grown together; scales in 13 rows; ventrals, 120; subcaudals, 14; anal single.

*Color in life*.—Above blue-black to purplish black, highly iridescent; below lavender to black with lighter cream-colored areas along anterior part of belly.

*Measurements of the type of Calamaria joloensis* sp. nov.

	mm.
Total length	150
Snout to vent	140
Tail	10
Width of head	4

*Remarks.*—This single specimen was taken on Jolo Island, under a rock in a small dry brook. I do not believe an apology is necessary for adding this species to the already very large assemblage of species of *Calamaria*. The very low ventral count and the absence of marking easily differentiate it from other Philippine species of the genus. The species seems to be nearer *Calamaria prakki* Lidth de Jeude, from which it differs in color, the very much shorter tail, and the very much smaller number of subcaudals.

*Calamaria grayi* Günther.

*Calamaria grayi* GÜNTHER Cat. Col. Snakes (1858) 6; TAYLOR, Snakes of the Philippine Islands (1922) 184.

A specimen of this rare species (No. 1034, E. H. Taylor collection) was taken at Zamboanga, near Pasananka, in a small stream that enters Tumugao River above the waterworks' intake. It was found under a rock which was at the water's edge. The species varies from Boulenger's description, in that the head is flattened and distinct from the neck, and the frontal is twice the width of the supraoculars.

*Color in life.*—Head dirty white to yellow-cream with a brown band between the eyes and involving the eye; grayish markings on the prefrontals and the rostral; the anterior part of the body has grayish rings, one scale wide dorsally and covering three or four ventrals below; toward the posterior part of the body the light rings are broken, and a series of gray spots follows the median line; below, the posterior part of the body is like the anterior. Ventrals, 191; subcaudals, 18; anal single.

*Measurements of Calamaria grayi* Günther.

	mm.
Total length	195
Snout to vent	183
Tail	12
Width of head	5
Width of neck	4

*Remarks.*—In my monograph on Philippine snakes<sup>6</sup> I state that only the types have been collected. This statement is doubtless erroneous, since Steindachner<sup>7</sup> records *Calamaria philippinica*, which is regarded as a synonym of this species.

<sup>6</sup> Snakes of the Philippine Islands, Bureau of Science publication 16 (1922) 312.

<sup>7</sup> Verh. Zool. Bot. Ges. Wien 17 (1867) 13, figs. 4–6, a paper which I have not seen.



## ILLUSTRATIONS

### PLATE 1

- FIG. 1. *Philautus basilanensis* sp. nov. Photograph of cotype (No. 1699A). Actual size of specimen, snout to vent, 22 millimeters.
2. *Philautus basilanensis* sp. nov. Photograph of type (No. 1510). Actual size, snout to vent, 21 millimeters.
3. *Philautus williamsi* sp. nov. Photograph of cotype from Polillo (No. 358). Actual size, snout to vent, 15 millimeters.
4. *Philautus williamsi* sp. nov. Photograph of type from Polillo (No. 356). Actual size, snout to vent, 21 millimeters.
5. *Philautus williamsi* sp. nov. Photograph of cotype from Polillo (No. 359). Actual size, snout to vent, 15 millimeters.
6. *Philautus williamsi* sp. nov. Photograph of cotype from eastern coast of Luzon. Actual size, 15 millimeters.
7. *Philautus zamboangensis* sp. nov. Photograph of type (No. 1059). Actual size, snout to vent, 28 millimeters.

### PLATE 2. PHILAUTUS POLILLENSIS SP. NOV.

- FIG. 1. Photograph of cotype (No. 353). Actual size, snout to vent, 19 millimeters.
2. Photograph of cotype (No. 352). Actual size, snout to vent, 15 millimeters.
3. Photograph of type (No. 351). Actual size, snout to vent, 27 millimeters. The folds across the snout and between the eyes are not normal.
4. Photograph of cotype (No. 350). Actual size, snout to vent, 20 millimeters.

### PLATE 3

- FIG. 1. *Kaloula kalingensis* sp. nov. Photograph of type (No. 824). Actual size, snout to vent, 36.5 millimeters.
2. *Kaloula kalingensis* sp. nov. Photograph of cotype (No. 856). Actual size, snout to vent, 34 millimeters.
3. *Kaloula negrosensis* sp. nov. Photograph of cotype (No. 538A). Actual size, snout to vent, 29.5 millimeters. The photograph fails to show very characteristic markings on the back.
4. *Kaloula negrosensis* sp. nov. Photograph of type (No. 538). Actual size, snout to vent, 30 millimeters.
5. *Kaloula rigida* sp. nov. Photograph of cotype from Baguio (No. 710). Actual size, snout to vent, 46 millimeters.
6. *Kaloula rigida* sp. nov. Photograph of type (No. 768) from Kalinga. Actual size, snout to vent, 47 millimeters.

## PLATE 4

- FIG. 1. *Megalophrys hasselti* (Tschudi). Photograph of a specimen from Abung-abung, Basilan (No. 1597A). Actual size, snout to vent, 55 millimeters.
2. *Bufo mcgregori* sp. nov. Photograph of type (No. 1468A). Actual size, snout to vent, 37 millimeters.
3. *Bufo mcgregori* sp. nov. Photograph of cotype (No. 1468B). Actual size, snout to vent, 37 millimeters.

## PLATE 5

- FIG. 1. *Gekko smaragdinum* sp. nov. Photograph of type specimen. Actual length, body and tail, 133 millimeters. The very characteristic black spots on the anterior part of the body are scarcely evident in the photograph.
2. *Gekko porosus* sp. nov. Photograph of type. Actual length, body and tail, 111 millimeters.

## PLATE 6. DRYOCALAMUS MCCRORYI SP. NOV.

- FIG. 1. Drawing of head of type, side view.  $\times 3$ .
2. Drawing of head of type, top view.  $\times 3$ .
3. Photograph of type specimen. Actual length, 350 millimeters.

## PLATE 7

- FIG. 1. *Siaphos herrei* sp. nov. Drawing of head of type, top view.  $\times 4$ .
2. *Calamaria joloensis* sp. nov. Drawing of head of type, side view.  $\times 4$ .
3. *Calamaria joloensis* sp. nov. Drawing of head of type, top view.  $\times 4$ .
4. *Pseudorhabdium minutum* sp. nov. Drawing of head of type, side view.  $\times 4$ .
5. *Pseudorhabdium minutum* sp. nov. Drawing of head of type, top view.  $\times 4$ .
6. *Typhlogeophis ater* sp. nov. Drawing of head of type, side view.  $\times 4$ .
7. *Typhlogeophis ater* sp. nov. Drawing of head of type, top view.  $\times 4$ .



PLATE 1. NEW SPECIES OF PHILAUTUS.







1



2



3



4

PLATE 2. PHILAUTUS POLILLENSIS SP. NOV.







PLATE 3. NEW SPECIES OF KALOULA.





PLATE 4. PHILIPPINE TOADS.

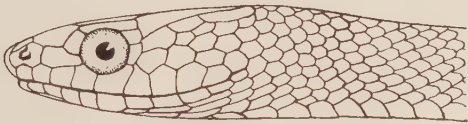




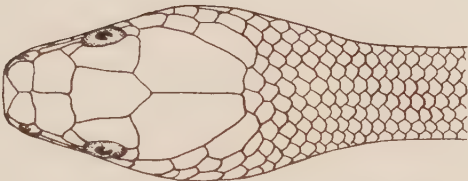


PLATE 5. NEW SPECIES OF GEKKO.

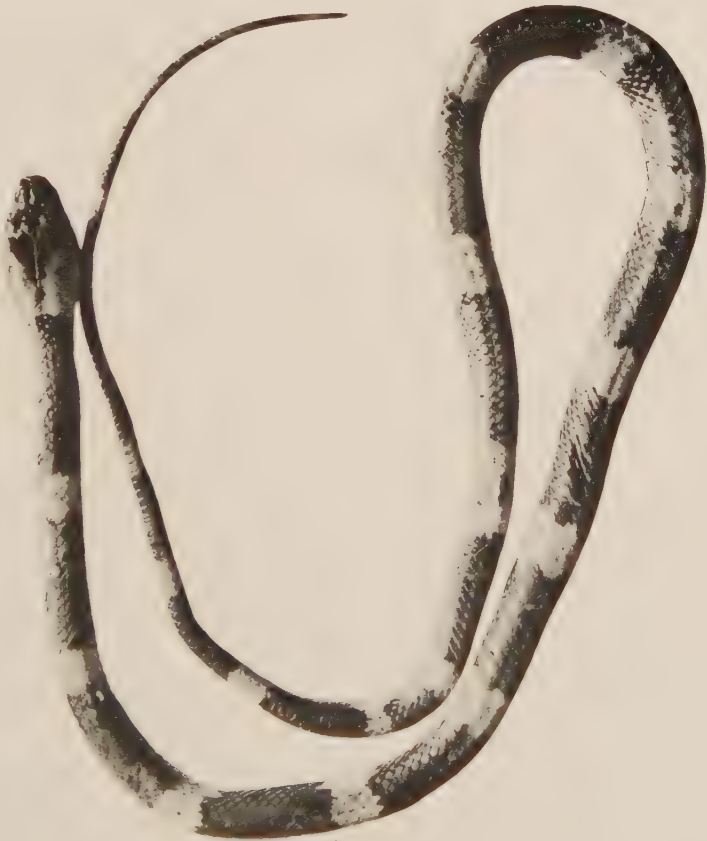




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2



3

PLATE 6. DRYOCALAMUS MCCRORYI SP. NOV.





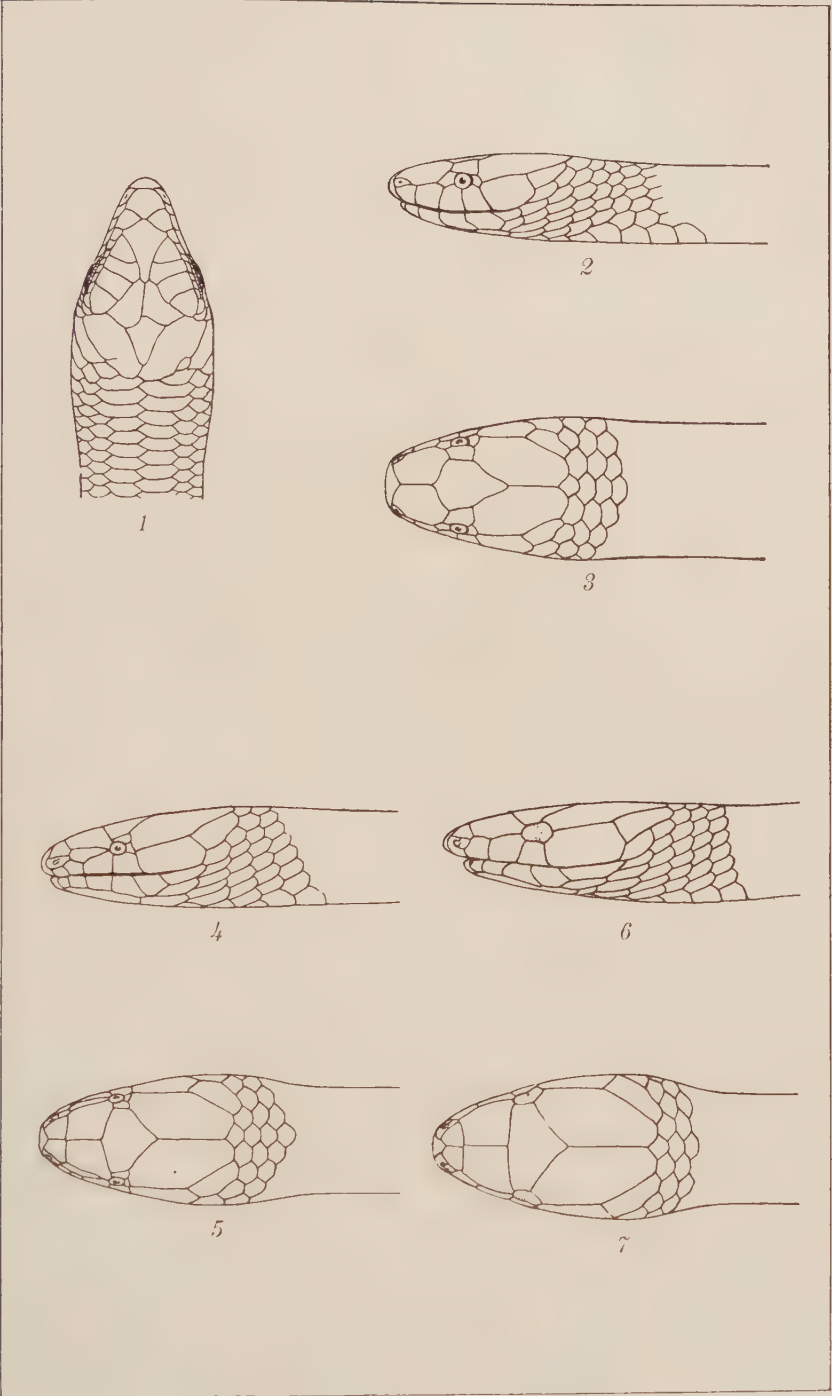


PLATE 7. NEW PHILIPPINE REPTILES.



# COPELANDOSPHAERA, A NEW GENUS OF THE VOLVOCEAE

By WALTER R. SHAW

*Of the Department of Botany, College of Liberal Arts, University of the  
Philippines*

FOUR PLATES AND TWO TEXT FIGURES

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Maturing sexual coenobia.	
Observations on living speci- mens.	
The manner of birth.	
A freak coenobium.	

## INTRODUCTION

In collections of the Volvocaceae made in the vicinity of Manila during the latter months of 1914 and 1915 there occurs a new member of this family that has the general appearance of a *Volvox*. However, its cells lack the protoplasmic connecting strands that are characteristic of *Volvox*. This, supplemented by other differences, I take as ground for considering it as not properly to be classed as a *Volvox*. It differs from its nearest affinity on one side, *Besseyosphaera*, established by Shaw ('16) and based on the "second form of *Volvox*" described by Powers ('07), in having its gonidia (the asexual reproductive cells) differentiated before the completion of the growth divisions and segmented before the birth of the coenobia in which they occur. It differs from its affinity on another side, *Merrillosphaera*, established by Shaw ('22B) based on *Volvox carteri* Stein ('78) which in turn was originally described by Carter ('59) under the name *Volvox globator*, in having the gonidia not differentiated in an early stage of the embryonic development, not becoming very large before segmentation, and not being symmetrically arranged in pairs or fours.

It may be distinguished from still another similar genus, *Campbellospheera*, described by Shaw ('19), by the absence of a vacancy in the layer of somatic cells of a mother over the gonidia and the daughters developed from the gonidia. In that genus the gonidia are not formed from cells in the coenobium wall at the places where they are to grow and develop into daughters, but come from the outside of the coenobium to take up places within. In the species which forms the subject of this paper the gonidia are differentiated from the somatic cells late in the prenatal development of the asexual daughters in which they are formed. As they grow they sink below the level of the somatic protoplasts, leaving a vacancy in the layer of protoplasts.

This new species will be treated as the type of a new genus, to be called *Copelandosphaera*<sup>1</sup> as a token of recognition of the work of Edwin Bingham Copeland on the phylogeny of the ferns of the Oriental Tropics. The first specimens observed were living, and some of them appeared to be setting free their vegetative cells or somatic protoplasts, whence the name *dissipatrix* that will be applied to the species. The use of this name is not intended to imply that the behavior to which it refers is habitual; nevertheless, it may serve to direct attention to a possible recurrence of the phenomenon in this or other species of the family under circumstances that may admit of following the history of the detached vegetative cells.

COPELANDOSPHEERA DISSIPATRIX GEN. ET SP. NOV.

DESCRIPTION OF TYPE SPECIMEN

For the type of *Copelandosphaera dissipatrix* a mature asexual specimen, represented by Plate 2, fig. 6, and Plate 3, fig. 13, has been selected. It is in a Venetian turpentine mount of material that was collected at Pasig, near Manila, in August, 1914. The collection from which the slide was prepared was numbered XVI.<sup>2</sup> The material was stained with a combination of nigrosin and Bismarck brown.

<sup>1</sup> The use of this name was forecast in a footnote of an earlier paper (Shaw '19, p. 513).

<sup>2</sup> The slide bearing the type specimen is in my possession. Slide mounts of material collected not far from the type locality in the same year have been sent to Prof. F. G. Haughwout, Bureau of Science, Manila, P. I., and to Prof. D. H. Campbell, Stanford University, California. Material from the same locality, bottled in glycerine, has been sent to thirty-two biologists in the Northern Hemisphere. Duplicates of this bottled material are available for distribution from my American address: Claremont, California.



The specimen is a globose coenobium containing nine daughters that fill the middle and hindmost thirds of the mother and cause the wall of the rear half of the mother to bulge out into the form of large, closely set bosses.<sup>3</sup> The specimen is compressed under the cover glass to about  $400\ \mu$  and measures  $1,050\ \mu$  wide and  $1,015\ \mu$  long. The number of cells in the mother was estimated at 52,600, the average spacing of the protoplasts being about  $8.5\ \mu$ . The front of the coenobium is turned away from the observer about  $25^\circ$ .

The somatic protoplasts are ovoid or ellipsoidal. In the front of the coenobium they measure about 5 by  $8\ \mu$ . At the sides and back they are somewhat smaller. The thickness of the space occupied by the layer of somatic cells with their membranes is about 14 to  $19\ \mu$  in different parts of the front, and about  $10\ \mu$  at the back over the daughters.

The nine daughter coenobia are arranged in a way that leaves one vacant space in the back part of the group. Four daughters that lie in the median optical section of the mother press the wall of the latter out to form bosses that are of a height equal to one quarter or more of the diameters of the daughters. The daughters are all more or less ellipsoidal, the smallest measuring 275 by  $315\ \mu$  and the largest 315 by  $365\ \mu$ , the average dimensions being 298 by  $322\ \mu$ . An estimate of the number of cells in the smallest daughter gave 15,000, the protoplasts being about  $2.5\ \mu$  in diameter and the spaces between about  $1\ \mu$ .

All of the daughters are asexual. The largest contains ten gonidia of about  $21\ \mu$  diameter. The smallest contains 2-celled embryos of about  $21\ \mu$  diameter and 4-celled embryos of about  $22\ \mu$  diameter. The largest embryos are 8-celled ones measuring  $30\ \mu$ . The numbers of the reproductive bodies in the daughters are:

6, 7, 8, 9, and 10 reproductive bodies in  
2, 2, 3, 1, and 1 daughters, respectively.

The most-advanced embryos, 8-celled, are in the four daughters that are nearest the front of the mother.

The thickness of the layer of somatic cells of a daughter with their membranes can be made out by direct microscopic observation of the daughter that bulges out on the right side of the mother. There is a line parallel with the peripheral boundary of the daughter and about 10 to  $12\ \mu$  below it. This is shown in

<sup>3</sup> This bossed condition of the mature asexual coenobium is partly, if not wholly, a result of the manner in which the shrinkage produced by the mounting medium has taken place.

fig. 1. The protoplasts are in less than the outer half of the space between these two limits. Where a gonidium or embryo occurs in the median optical section of the daughter the inner boundary of the somatic membranes is deflected inward to form a lenticular thickening just thick enough to include the reproductive body between its inner limit and the layer of somatic protoplasts. Such a 2-celled embryo measured  $18\ \mu$  thick and about  $23\ \mu$  wide. This embryo, then, if my interpretation of the line  $i'$  in fig. 1 be correct, occupies the center of a lenticular thickening of the body wall of the daughter that is equal in thickness to the radial dimensions of the peripheral lamella, the somatic protoplasts, and the embryo combined.

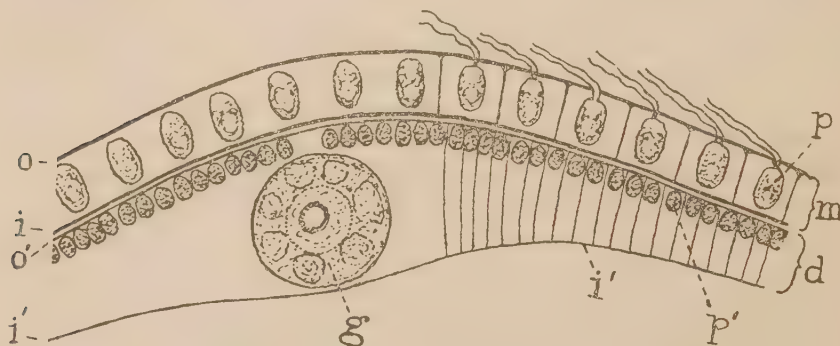


FIG. 1. Optical section through mother and daughter coenobia of the type specimen in Venetian turpentine. In the right half of the figure the invisible bounding lamellae of the separate cells are drawn as they are supposed to be. The somatic wall,  $m$ , of the mother with its protoplasts,  $p$ , is included between its outer membrane,  $o$ , and its inner membrane,  $i$ . The wall,  $d$ , of the daughter between its outer,  $o'$ , and inner,  $i'$ , membranes contains the layer of smaller protoplasts and the gonidium,  $g$ . Semidiagrammatic.  $\times 1,000$ .

None of the 8-celled embryos are in positions that are favorable for showing the inner limit of the membranes of the coenobial wall.

Embedded in the coenobium wall are numerous endophytic algae of a species probably belonging to the genus *Chlorosphaera* Klebs. They are most numerous on the front of the coenobium and are present in a great variety of stages.

#### OTHER ASEXUAL COENOBIA

A less-mature coenobium (specimen 2) with daughters nearly or fully formed is shown in Plate 2, fig. 9. This is on the same slide as the type specimen. The coenobium measures  $535$  by  $525\ \mu$ , and the daughters range from  $140$  by  $174$  to  $190$  by  $200\ \mu$ . There are ten daughters. They are more nearly in two circles of five each than in fours or pairs, but the members of a

circle are not all in the same plane. The daughters have apparently completed their growth divisions, and gonidia can be seen in all but two; these two I believe to be sexual daughters. Measurements of somatic cells were made in three daughters and of gonidia in eight. For the somatic cells the measurement is space per cell obtained by measuring a straight row of five cells and dividing by five. The gonidia in any one daughter are of about the same size. Examples showing the extremes are:

Width of somatic cells	2.9, 3.2, 3.2 $\mu$
Diameter of gonidia	5.0, 8.6, 11.0 $\mu$

The gonidial protoplasts are sunk below the level of the somatic protoplasts. Over each daughter on the nearer side of the mother the vacancy in the layer of somatic protoplasts of the mother forms an elongated space that is surrounded by seven or eight protoplasts.

*Specimen 2A.*—On the same slide with the previously described specimens there is a very much shrunken mother coenobium with six daughters that are plump. One of these is asexual, and five are sexual. The somatic cells of the mother measure about 5  $\mu$  wide. The asexual daughter measured about 225 by 255  $\mu$ , consisted of about 23,000 cells about 3  $\mu$  wide, and contained five gonidia that ranged from 18 to 21  $\mu$  in diameter. The sexual daughters ranged in size from 230 by 245 to 230 by 265  $\mu$ , and in number of cells from about 13,000 to about 26,000. The reproductive bodies measured about 9  $\mu$  in diameter in the sexual daughters, and in one they were estimated to number about 190.

Most of the micrographs used to illustrate the species were made from material collected at Pasay, near Manila, from a pond called J for labeling material from that source. The material was collected October 13, 1914, and mounted in glycerine. The photographed specimens will be described first.

*Specimen 3.*—Plate 2, fig. 8. This is a young coenobium with fifteen embryonic daughters in about the 64-celled stage. The photograph shows that the phialopores of the embryos, each of which is directly under the vacant space in the somatic layer of the mother, are still open. The mother measures about 346  $\mu$  both ways. The protoplasts are about 4 to 5.5  $\mu$  wide. Their spacing is about 10  $\mu$ , and the number of cells is about 4,300. The daughters measure about 29 to 43  $\mu$  in diameter.

*Specimen 4.*—Plate 2, fig. 10. This coenobium, shown on a smaller scale, contains eight more-advanced embryos. The



mother measures 560 by 604  $\mu$ . The cell spacing is about 9  $\mu$ , and the number of cells is about 14,700. The embryo daughters measure from 62 to 75  $\mu$  and have their cells about 7  $\mu$  wide. The number of cells in these embryos is between 256 and 512.

*Specimen 5.*—Plate 2, fig. 7. This coenobium, which also is shown on a smaller scale, contains four embryo daughters. The mother measures about 472 by 517  $\mu$ . The cell spacing is about 12  $\mu$ , and the number of cells is about 6,000. The daughters measure about 125 by 118  $\mu$ , being wider than long, and their average cells measure about 6 by 9  $\mu$  and have very thin walls. The number of their cells is about 1,024; that is to say, ten divisions have been accomplished. The capsules of the daughters are separated from their somatic cells by distances of about 10  $\mu$  around the equators, but are in contact with both poles of the daughters.

*Specimen 6.*—Plate 3, fig. 11. A coenobium with ten embryo daughters. The preparation bearing this and the next specimen dried up before measurements were made. From the picture we find the dimensions to be about 590 by 620  $\mu$ ; the spacing of the cells, about 9  $\mu$ ; and the number of cells, about 16,000. The embryo daughters are about 100 and 110  $\mu$  in diameter.

*Specimen 7.*—Plate 4, fig. 16. This is a more-mature coenobium with only six daughters. Measurement of the photograph gives dimensions of 630 by 700  $\mu$  and cell spacing about 12  $\mu$ . The number of cells is about 10,900. The largest daughter measures about 200 by 230  $\mu$ .

*Specimen 8.*—Plate 4, fig. 14. A less-mature coenobium with ten daughters. The mother measures about 680 by 720  $\mu$ ; it has cells spaced about 12  $\mu$  and numbering about 12,000. The daughters are about 130 to 160  $\mu$  in diameter. The unclosed phialopores of the two nearer daughters can be seen in the picture. In all observed cases this opening is directly underneath the vacant space left in the somatic layer by the cell that became the gonidium.

#### YOUNG COENOBIA

In both of the collections from which the specimens already described were selected there occur sexual coenobia. In the glycerine preparations from Pond J they are present in a great variety of stages, from unborn to nearly mature. They occur in the same mother with asexual daughters in various proportions. Measurements of some of these will serve to show



the condition of the two kinds of coenobia before and at the time of birth.

*Specimen 9.*—A very nearly mature coenobium (not figured) with one sexual and five asexual daughters is very much shrunk, though the daughters are not. The sexual daughter measures 257 by 287  $\mu$ , has somatic protoplasts about 3.5  $\mu$ , and numerous oogonidia of about 12  $\mu$ . The largest asexual daughter measures 272  $\mu$  each way and has six gonidia of which some are undivided and others divided into two cells. These gonidia measure about 20 to 22  $\mu$ . The smallest daughter measures 215 by 236  $\mu$  and has seven gonidia that measure about 18  $\mu$ .

*Specimen 10.*—An overmature coenobium (not figured) with two remaining daughters, both asexual. The mother is much shrunk and has large holes in the wall. The daughters are terete. One daughter presents a side view and measures 280 by 310  $\mu$ , and contains ten embryos that are 8-celled and measure about 25  $\mu$ . The embryos of the other daughters are of the same number, size, and stage.

*Specimen 11.*—A glycerine preparation of material from Pond E in Pasay on October 12, 1914, bears an abundance of material of this species of which one specimen should be noted here. It is a very mature, somewhat shrunk coenobium (not figured) with three remaining daughters caught at the time of fixing the material in the act of passing out, each through its own hole in the wall of the mother. About one-fourth to one-third of each is out. The two sexual coenobia are coming out forward end first, and the asexual one is coming out hind end first. The asexual daughter measures 345 by 385  $\mu$  and contains seven embryos that are 8- or 16-celled and measure 29  $\mu$  wide. The sexual daughters measure 365 by 440  $\mu$  and 370 by 460  $\mu$  and have numerous oogonidia of about 15 to 17  $\mu$  and of about 14  $\mu$ , respectively.

In the young sexual coenobia that have been described the reproductive cells are all of about the same size in each coenobium, and have apparently been formed from cells of the body layer after the last cell division of growth, for the vacant space left when the oogonidial protoplast sank below the level of the somatic layer is not much larger than that occupied by each neighboring somatic cell. The gonidia, on the other hand, appear to have been differentiated before the last division, but precisely when is still an unanswered question.

## MATURING SEXUAL COENOBIA

We will pass to a consideration of sexual coenobia that are approaching maturity and describe the one<sup>4</sup> that is represented by Plate 1, figs. 1 to 3. This and the two sexual coenobia that are shown on the next plate are in the lot of glycerine preparations that were made from the Pond J material from Pasay, October 13, 1914.

*Specimen 12.*—Plate 1, fig. 1, shows a sexual coenobium with antheridia very nearly mature. This specimen is a slightly ovoid coenobium about 610 by 660  $\mu$ . The number of cells forming the coenobium was estimated to be about 17,600. The protoplasts of the cells are ovoid and measure about 6 by 7  $\mu$  in the front and 4 by 5  $\mu$  in the middle and back of the coenobium. The distance between the protoplasts is greatest in the front and grades to the minimum at the back. The oogonidia when counted in a camera lucida sketch were found to be 127. They are distributed in about three-fourths of the length of the coenobium and are slightly more crowded in the hindmost quarter than elsewhere. They are globular and measure about 28  $\mu$  in diameter. Their outer sides are only about 10  $\mu$  below the outside surface of the coenobium. The antheridia that can be seen are ten, and they are not all grouped in pairs like the four shown in the photograph. Each antheridium consists of a platelet about 37  $\mu$  wide and 10  $\mu$  thick, slightly dished, consisting of about 256 closely packed sperms.<sup>5</sup> The vacant spaces in the coenobium wall over the two antheridia that can best be seen are large enough to have seven protoplasts around them. They are, if different, larger than the spaces above the oogonidia, most of which seem to have not much more than six protoplasts around them.

*Specimen 13.*—Plate 2, fig. 4, shows a nearly mature sexual coenobium on a smaller scale. The picture was taken with a focus below the middle of the specimen, and the oogonidia that show most plainly are those of the farther side. The coenobium measures 760 by 840  $\mu$ , the spacing of the cells is about 10.7  $\mu$ , and the number of cells about 19,600. Few antheridial sites can be distinguished in the coenobium wall. The oogo-

<sup>4</sup>This one had been selected, at the time when the figures were made up into plates, to serve as the type of the species, but it is now thought that the characters of the genus are better shown by mature asexual coenobia with their contained daughters.

<sup>5</sup>This number was obtained by finding that the diameter of a platelet is about equal to 18 sperms in a straight row.

nidia are dense and, except one, without spore walls. They are about  $46\ \mu$  in diameter. The number present is 130. One oospore wall had developed around a reproductive body somewhat smaller than the others, about  $41\ \mu$  wide, that is of a more orange color than the others. The wall is yellowish and wavy and not very thick. The protoplast has not contracted within the wall of this spore.

*Specimen 14.*—Plate 2, fig. 5, shows a large sexual coenobium on the same small scale used for the preceding figure. It measures  $870$  by  $973\ \mu$ , has its cells spaced about  $10.7\ \mu$ , and contains about 25,800 cells. There appear to be two empty antheridial sites on the nearer and one on the farther side. The oogonidia are about  $46\ \mu$  wide and are all dense and without spore walls. They number about 112.

*Specimen 15.*—In the same Venetian turpentine preparation with the type specimen there is a sexual coenobium that is figured in Plate 4, fig. 15. It is very much shrunk. It contains eighty-one reproductive bodies of which all but ten have more- or less-developed, smooth spore walls from which in some cases the dense portion of the protoplast has contracted. They measure about  $42$  to  $43\ \mu$ . Some of them are shown on a larger scale in Plate 3, fig. 12.

#### OBSERVATIONS ON LIVING SPECIMENS

The paucity of recorded observations in my notes on living specimens of this species is due largely to the fact that in most collections the species was accompanied by several more-puzzling species of the same family. Descriptive data from these notes will be given to supplement those obtained from material in glycerine and Venetian turpentine.

*Specimen 16.*—A living specimen in a collection from Pasig, August 4, 1914. This was an asexual coenobium with ten daughters and measured  $900$  by  $950\ \mu$ . It was observed to have no protoplasmic connections between the cells. The surface of the coenobium was smooth.\* The protoplasts of the mother measured about  $6\ \mu$  wide and were estimated to number 13,000. Measured daughters were  $220$  by  $270\ \mu$ ,  $260$  by  $300\ \mu$ , and  $270$  by  $300\ \mu$ . The cells of the daughters were about  $4\ \mu$  in diameter, and the gonidia of the daughters about  $18\ \mu$  in diameter.

*Specimen 17.*—On August 5, 1914, observations were made on living material that had been collected at Pasig the day before.

\* In this respect it differed from *Campbelllosphaera*, which was represented in the same collection.



Many of the coenobia showed numerous bald spots of irregular form and varying size. From these spots the cells were gone. Around the borders of these spots some cells appeared to be partly loosened and about to escape. In the morning specimen 17, with very large daughters, was placed in a glass ring under a cover glass. By 1.30 in the afternoon cells had disappeared from a very large area, and the water in the ring was full of green, motile cells of about the same size.

*Specimen 18.*—August 5, 1914. In material collected the day before and kept in a watch glass an asexual coenobium with eight daughters measured 1,630 by 1,860  $\mu$  and was estimated to contain 20,200 cells. The daughters were all in the hindmost half of the mother and were about 370 by 440  $\mu$ . The somatic protoplasts of the daughters were about 4  $\mu$  wide and almost in contact with one another. The number of these protoplasts was estimated to be 14,820. The gonidia in the daughters were about 28  $\mu$  in diameter.

*Specimen 19.*—August 5, 1914. In the same material as the preceding a sexual coenobium from which the anterior fifth was gone measured (restored) 620 by 660  $\mu$ . It contained oogonidia distributed beneath the remaining portion of the coenobium wall. The cells of the coenobium were ovoid and measured about 5  $\mu$  wide. The number of cells was estimated to be about 19,450. The oogonidia were about 25  $\mu$  wide, and their number was estimated to be about 500.<sup>7</sup>

*Specimen 20.*—August 20, 1914. In material from Pasig a coenobium with nine daughters measured 1,950 by 2,250  $\mu$ . The lateral protoplasts measured 4.5 to 5  $\mu$ , and they were 15 to 20  $\mu$  apart. The number of cells was estimated to be about 25,900. The daughters were all of about the same size, 450 by 530  $\mu$ . The reproductive bodies in the daughters were all embryos of about the same age and size. They measured about 30  $\mu$  wide and were 16- or 32-celled spheres, each with an opening (phialopore) of about the size of one cell.

*Specimen 21.*—December 15, 1917. From living material from Pond E in Pasay one sexual coenobium was mounted in a hanging drop. It measured 800 by 900  $\mu$  and consisted of about 10,700 cells. It contained forty-eight orange oospores and four green oogonidia, of which none were in the forward

<sup>7</sup>It was observed that there were about 4 of the oogonidia per area 90 sq.  $\mu$  which corresponds to about 623 for the whole spheroid. From this number 123 was deducted for the anterior fifth which presumably contained no reproductive cells.



third of the coenobium. The oospores had a smooth outer wall about  $46\ \mu$  in diameter and a smooth inner wall about  $42\ \mu$  in diameter. The space between the membranes appeared to be occupied by a substance with large vacuoles.

#### THE MANNER OF BIRTH

Each daughter coenobia makes its exit from the mother through a separate opening formed in the wall of the mother. This is well illustrated by specimen 11, already described. After the departure of the daughter the opening remains with a smooth outline. This birth of the daughters through separate holes is in striking contrast with the manner of birth in another species that was first observed in the same habitat with *Copelandosphaera*. In that one, the species of *Campbelllosphaera*, as has been recorded elsewhere (Shaw, '19, p. 494), the daughters nearest the hinder pole mature first and are liberated one by one through an opening in the back of the mother, through which all the other daughters pass in turn.

#### A FREAK COENOBIUM

On the same slide with the Pond E material that includes specimen 11 with an abundance of mature and other coenobia there is one specimen, a sexual coenobium with oogonidia a little over half grown, with a deep equatorial constriction, which at first sight appears to have been produced by a birth that was long interrupted when the daughter was halfway out. This coenobium is widened and shortened to  $610$  by  $560\ \mu$ . A normal coenobium of about the same age is about  $30\ \mu$  longer than broad. The furrow is about  $70\ \mu$  deep on the nearer side of the coenobium, and the sides of the furrow are in contact for some distance from the bottom. The median section effect is that of a closed furrow between two rounded ridges. The furrow is slightly in advance of the equator, and there is one row of reproductive cells in front of it, all the others being on the furrow or behind it. The coenobium wall, then, consists of two nearly equal parts, each with a flange on the inner side of the line of union, the parts being united by the inner edges of the flanges.

Some of the measurements of coenobia and numbers of somatic and reproductive cells are given in Table 1. Certain of the figures greatly exceed the general range of those recorded, yet the table will serve its purpose even though some of the extreme figures are not above suspicion of error.

TABLE 1.—*Sizes of coenobia and numbers of cells in Copelandosphaera dissipatrix gen. et sp. nov.*

## ASEXUAL COENOBIA.

Specimen No.	Greatest diameter.	Somatic cells.	Reproductive cells.
	$\mu$ .		
20 -----	2,250	25,900	9
18 -----	1,860	20,000	8
Type -----	<sup>a</sup> 1,050	52,600	9
16 -----	950	18,000	10
8 -----	<sup>b</sup> 720	12,000	10
7 -----	<sup>b</sup> 700	10,900	6
4 -----	<sup>b</sup> 604	14,000	8
6 -----	<sup>b</sup> 590	16,000	10
5 -----	<sup>b</sup> 517	6,000	4
SEXUAL COENOBIA.			
14 -----	<sup>b</sup> 973	25,000	112
13 -----	<sup>b</sup> 840	19,600	130
19 -----	660	19,000	500
12 -----	<sup>b</sup> 660	17,600	127
22 ° -----	<sup>b</sup> 680	11,500	60
21 -----	900	10,700	52
24 ° -----	<sup>b</sup> 530	10,700	47
25 ° -----	<sup>b</sup> 545	9,600	64
23 ° -----	<sup>b</sup> 540	9,200	50

<sup>a</sup> Venetian turpentine preparation.<sup>b</sup> Glycerine preparation.<sup>c</sup> Not described.

## COPELANDOSPHERA SPERMATOSPHERA (POWERS) COMB. NOV.

Powers ('07) gave a description of a form that he distinguished as his "first form of *Volvox*" based on material collected from a shallow remnant of a prairie pond containing considerable alkali. In the following year he extended the description to embrace the characters of material received from the State of Washington, from Missouri, and possibly from Louisiana, and named it *Volvox spermatosphera* Powers ('08). The name was emended by West ('10) to *V. spermatosphaera*. Powers's description is the most complete ever written by the author of any new species of the Volvocaceae, and his beautiful photomicrographic figures mark the beginning of a new epoch in the study of the members of this family. Our knowledge in this field will not begin to be satisfactory until we have similar photographic illustrations of all the known species of the group.

The shape of the coenobia, described by Powers ('08, pp. 145 and 151) as uniformly and strongly oval, might possibly better be characterized as strongly ellipsoidal, for they do not have one end regularly larger than the other as is commonly the case in

*Volvox africanus* West ('10) which appears in West's photo-micrographic figures and in photographs of some of my own material. The coenobia of that species are commonly more truly egg-shaped in having one end, the forward one, larger than the other, and are properly described as ovoid. In *Copelandosphaera spermatosphaera* the ellipsoidal form is strongly marked in the young coenobia, and is evident before birth, except in the sperm spheres, which are spherical (Powers '07, p. 129).

The size of the mature coenobia in Powers's first collection of this species ranged between 500 and 1,000  $\mu$ . Material subsequently collected in Nebraska gave maximum dimensions for mature coenobia with vegetative or mixed content of 600 to 650  $\mu$ , and for coenobia with oospores alone of about 500  $\mu$ . The smallest coenobia containing mature sperm spheres were as small as 150  $\mu$  or even smaller. The most frequent size of mature coenobia in a large collection from Missouri was not far from 350  $\mu$ . In the larger mothers the size of the daughters at birth was about 250  $\mu$ ; in smaller ones they frequently escape at 100  $\mu$  or less.

The number of cells in the coenobia was estimated by Powers to be between 1,000 and 3,000. When coenobia with smaller numbers of cells produce daughters with larger numbers, the progeny, though present in medium or smaller numbers, fill the entire cavity of the mother and stretch the maternal coenobial wall out of its original shape. This was illustrated by figures of overcrowded mothers (Powers '08, pl. 24, figs. 20, 23, and 26). When, on the other hand, the number of cells in the daughter coenobia is the same as or less than the number in the mother there is ample room for the progeny in the posterior half or three-fifths of the mother.

The somatic cells of the adult coenobia were stated by Powers to range from 6 to 10  $\mu$ , most of them being of the smaller size. The distance separating them was given as usually 28 to 40  $\mu$ , though sometimes as great as 50  $\mu$ . The somatic cells in the daughters at the time of birth were stated to be about 5  $\mu$ , and Powers found that they increase to nearly or quite full size by the time the gonidia begin to divide.

In shape the somatic cells were stated to resemble most the figures which Meyer gave for his *Volvox tertius* (Powers '07, p. 139, Meyer '96, pl. 8, fig. Z), and like them they showed no signs of any connecting protoplasmic filaments between the neighboring protoplasts. From such observations as he made



on the cell membranes, Powers received the impression that these also resemble those of *V. tertius*.

A well-developed stigma in each of the somatic cells about the anterior pole of the coenobium was observed by Powers ('08, p. 150), and in the cells farther from that pole the stigmata were proportionately smaller, until a little back of the coenobial equator they were no longer visible as colored bodies. Powers was unable to decide whether at the posterior pole they were really quite absent, or whether one of a group of small colorless granules was the homologue of a pigment body. No recognizable stigma could be seen about the posterior pole even with an immersion lens. The stigmata about the anterior poles were visible in the daughters before birth.

Reproductive cells of one, two, or three kinds occur, according to Powers, in the same coenobium in numbers ranging from one to twenty-five, the numbers being about the same regardless of what kind or kinds were present. These reproductive cells are evidently differentiated at about the 256-celled stage of the development of the daughter coenobium. That such is the case appears from a comparison of the reproductive cells of a daughter coenobium with the cells of a sperm sphere found in the same mother (Powers '07, pl. 13, figs. 13 and 14). This sperm sphere consists of about 256 roundish cells, the maximum number for such a structure. The reproductive cells in the neighboring daughter coenobium are very similar in size and shape to these sperm-sphere cells, a fact which indicates that they were formed at the 256-celled stage and remained undivided while the somatogenic cells divided three times, producing about 1,800 somatic cells.

The number of reproductive cells in the daughter coenobia within four mother coenobia was determined by Powers ('07, p. 134) and they were found to occur with frequencies as given in Table 2.

TABLE 2.—Distribution of reproductive cells in the daughters contained in four mother coenobia of *Copelandosphaera spermatosphaera*.

[illegible]



The highest number of reproductive cells found after a moderate search was twenty-five. In material consisting of coenobia averaging smaller in size than the first lot the average number of reproductive bodies is somewhat smaller, and Powers ('08, p. 145) reported a marked tendency for the coenobia to contain exactly eight oogonidia ("ova"), but the number was frequently increased to eleven or more.

The various combinations of reproductive bodies present in one hundred coenobia that were sufficiently mature for distinguishing between the different kinds, taken as they occurred in the preparations, were recorded by Powers with the results that are given in Table 3. Sperm spheres alone in mother coenobia, though not found among any of this hundred, were otherwise of not infrequent occurrence. The largest number of daughter coenobia observed in one mother was twenty-two. The largest number of oospores observed in one coenobium was reported as nineteen. The largest number of sperm spheres recorded was fourteen, and these were accompanied by two vegetative coenobia.

TABLE 3.—*Combinations of reproductive bodies in 100 matured coenobia of Copelandosphaera spermatosphaera.*

Number of mother coenobia.	Number of reproductive bodies.		
	Vegetative daughters.	Oospores.	Sperm spheres.
18	5-14		
5		7-16	
55	1-14		1-11
12	2-13	1-7	1-8

The gonidia have, accordingly, at the time of differentiation diameters of about 9  $\mu$  (Powers '07, pl. 13, fig. 13), at the time of birth they measure about 15 to 18  $\mu$  ('07, p. 138), and at the time of segmentation, which is always considerably later than birth, they reach about 30 to 36  $\mu$ . Some rare cases illustrated by Powers ('07, pl. 13, fig. 18) of gonidia in which segmentation was delayed until they had reached a size of 51  $\mu$  are open to the suspicion of belonging to some other species. The segmentation of the gonidia was described as proceeding more slowly at first and then rapidly until the somatic cells are produced with diameters of about 3  $\mu$ , long before the young coenobia have closed to form complete spheres (Powers '07, p. 132). From this time on the somatic cells of the young coe-

nobia increase slowly in size throughout the entire period of growth.

The oogonidia, according to Powers, are reproductive cells like the gonidia, with which they may be mixed in the same coenobium. The highest number counted in coenobia which contained them alone was nineteen. They become larger than the gonidia, reaching 51 to 54  $\mu$ .

The oospores, according to Powers's photographs, develop a thick smooth wall within which the somewhat smaller protoplast is concentrically located.

The name androgonidia I will here apply to those reproductive cells which give rise to the sperm spheres. They occur mixed with the other reproductive cells in various proportions. They were described by Powers as about 1 to 3  $\mu$  smaller than the gonidia at the time of segmentation, and gave evidence of having cytoplasmic and nuclear structure different from that of the gonidia. They were found to segment more tardily than the gonidia to the extent that in their early stages the sperm spheres are one or two cell divisions behind the vegetative coenobia that develop from the gonidia.

The sperm spheres formed from the androgonidia, according to Powers, are *Eudorina*-like spheres of 32, 64, 128, or 256 cells, all of which proceed forthwith to divide and form sperm platelets, there being no somatic or vegetative cells among them. They have only rudimentary cilia and no power of locomotion. During the development of the sperm spheres the diameter of the constituent cells does not fall below 6  $\mu$ , whereas in the vegetative spheres the somatic cells become as small as 3  $\mu$ , though the reproductive cells appear to be about the size of the cells in the sperm spheres. The form of the sperm spheres, as before stated, was described as spherical, except when they were deformed by pressure.

A sperm platelet consisting usually of thirty-two spermatozooids though sometimes of sixty-four, is formed from each cell of the sperm sphere, the number of sperms being the same in all the platelets of a sphere. The sperm sphere with its platelets is functionally a compound antheridium and may be conveniently so styled.

The spermatozooids were described by Powers as compact, with spherical nuclei and terminal cilia ('07, p. 134).

## DIAGNOSES OF GENUS AND SPECIES

\*

Genus **COPELANDOSPHAERA** novum

(Volvocaceae, Volvoceae)

Body a spherical or ellipsoidal coenobium of biciliate cells that contain chloroplasts. The cells appear to lie in the periphery of a gelatinous matrix surrounded by a hyaline envelope through which the cilia protrude. Somatic protoplasts globose or ovoid, each inclosed in a thick gelatinous membrane that is more or less prismatic in form. No protoplasmic filaments connecting the protoplasts. Asexual reproduction by gonidia that are differentiated in late embryonic stages of the coenobia producing them. The gonidia develop to relatively moderate size before segmentation. Oogonidia and androgonidia in the same coenobia with gonidia or in sexual coenobia. Antheridia consisting of sperm platelets or of sperm spheres compounded of sperm platelets. Spermatozoids with terminal cilia.

The type species of this genus is the new species *Copelandosphaera dissipatrix*, described herewith from the Philippine Islands. One other species takes a place in this genus; namely, *Volvox spermatosphara* Powers, which was described from western North America. The diagnosis of that species given herewith is a revision of Powers's original definition and is made in accord with the details of his description and figures.

**COPELANDOSPHAERA DISSIPATRIX** sp. nov. Plates 1 to 4.

Coenobia spherical or ellipsoidal; asexual 1,000  $\mu$ , more or less (2,250  $\mu$  recorded), about 300 by 350  $\mu$  at birth; sexual 620 by 660  $\mu$ , more or less (973 recorded). Number of cells usually between 9,000 and 25,000 (52,600 recorded). Protoplasts globose to ellipsoidal, about 4 by 5  $\mu$  to 5 by 6  $\mu$  in diameter; about 3  $\mu$  wide at time of birth; spaced 8 to 20  $\mu$  apart (center to center). Stigmata large in cells about the anterior pole, gradually decreasing in size backward. Reproductive cells confined to the posterior half, three-fifths, or three-fourths of the coenobia. Gonidia in asexual coenobia; 4 to 15; not arranged in pairs or fours; differentiated at about the stage before the last two or three growth divisions; reaching about 20 to 22  $\mu$  and segmenting to produce embryos that are 8- to 16-celled by the time of birth or segmenting after birth. Early stages of embryos globose; later embryonic stages oblate; daughters becoming prolate before birth. Oogonidia and andro-



gonidia in the same sexual coenobia. Oogonidia mostly between 50 and 150; smaller and appearing later than the gonidia, in sister coenobia; differentiated at about the time of the growth divisions; about  $18\ \mu$  at time of birth; reaching about  $46\ \mu$ . Oospores with smooth or slightly wavy walls. Androgonidia few; about the same size as the oogonidia and scattered among them; each forming a sperm platelet of 256 sperms. Spermatozooids probably with terminal cilia.

*Habitat*.—Fresh-water pools near Manila, Philippine Islands (leg. W. R. Shaw, 1914).

**COPELANDOSPHAERA SPERMATOSPHAERA** (Powers) comb. nov.

"First form of *Volvox*," Powers in Trans. Am. Microscop. Soc. 27 (1907) 124-140, 146-148, pls. 11-13, figs. 1-17.

*Volvox spermatosphara* Powers in Trans. Am. Microscop. Soc. 28 (1908) 142-151, 171-172, pls. 23 and 24, figs. 1-23 and 26.

*Volvox spermatosphaera* (Powers) West in Journ. Quekett Mic. Club II 11 (1910) 101.

Coenobia spherical or ellipsoidal; 150 to  $1,000\ \mu$  (more commonly 250 to  $600\ \mu$ ) at maturity; about  $250\ \mu$  or less at time of birth. Somatic cells about 1,000 to 3,000; protoplasts globose to ovoid; 6 to  $10\ \mu$  in diameter (mostly nearer the smaller size); about  $5\ \mu$  at time of birth; spaced in adults 28 to 40 or even  $50\ \mu$  apart. Stigmata large in the cells about the anterior pole, gradually decreasing in size backward, and becoming invisible not far back of the coenobial equator. Reproductive cells 1 to 25, whether gonidia, oogonidia, androgonidia, or mixtures of two or three kinds in the same coenobium; confined to posterior half or three-fifths of the coenobium; differentiated from somatogenic cells at about the 256-celled stage; about 15 to  $18\ \mu$  at time of birth. The gonidia segment after birth, when they reach about 30 to  $36\ \mu$ , and produce vegetative coenobia. The oogonia mature at about 51 to  $54\ \mu$ . Oospores with a smooth wall around a concentrically placed zygote. Androgonidia 1 to  $3\ \mu$  smaller than the gonidia, and of different constitution; segmenting more tardily; each producing a hollow sphere of 32 to 256 weakly ciliated cells that segment forthwith and produce each a platelet of 32 or, sometimes, 64 sperms. The resulting compound antheridia or "sperm spheres" measure about 80 to  $180\ \mu$ , have no power of locomotion, and usually mature after fecundation of the eggs in the same coenobium. Spermatozooids compact, with spherical nuclei and terminal cilia.

*Habitat*.—The shallow remnant of a prairie pond containing considerable alkali, Nebraska (J. H. Powers, 1903?); shallow



bodies of water, Nebraska (J. H. Powers, 1904?); Washington State (Elda R. Walker, 1904?); a shallow pond, near Rocheport, Missouri (R. H. Wolcott, 1904); and probably New Orleans, Louisiana (E. Foster, 1904?).

#### THE RELATIONSHIPS OF COPELANDOSPHERA

It has been pointed out by Crow ('18) that *Stephanosphaera* and *Volvox* bear, in the characters of their cell membranes, cell connections, contractile vacuoles, and chloroplasts, a strong resemblance to the unicellular genus *Sphaerella*, whereas the other multicellular genera of the Volvocaceae resemble in these characters the unicellular genus *Chlamydomonas*. According to Crow, the relationships of these genera would be best expressed by grouping them into two families, the Sphaerellaceae and the Chlamydomonadaceae, that present two lines of evolution on parallel lines. Such an arrangement would bring into the Chlamydomonadaceae in this sense *Gonium*, *Pandorina*, *Stephanoon*, and *Eudorina* of lower organization, *Pleodorina* and *Besseyosphaera* of intermediate organization, and *Copelandosphaera*, *Merrillosphaera*, and *Campbelllosphaera* of higher organization. While such a disposition may represent the course of phylogeny, nevertheless the subfamily Volvoceae, embracing all the multicellular Volvocaceae, will be useful for practical purposes.

A key to the genera and species of Volvoceae, which is herewith presented, will serve to show the position of *Copelandosphaera* among its relatives.

The nearest relative to *Copelandosphaera* on the side of lower organization is *Besseyosphaera*, which has its gonidia not differentiated until after the birth of the coenobia. Although the sexual reproduction of the latter genus is not known, we can, without difficulty, picture it as something intermediate between that of *Copelandosphaera* and that of *Pleodorina californica* as described by Chatton ('11), and not greatly different from either.

The nearest relatives on the side of higher organization are the species of *Merrillosphaera*. The relationship is so close that some people may prefer to reduce them all to one genus. This would be undesirable at the present time, for it is almost certainly true that the assumption that all of *Volvox* is comprised in two or at most three species was, until the time of Powers's work, a deterrent to the proper study of such forms of this group as were found. In identifying them, if the form in hand had rounded protoplasts it was set down as *Volvox aureus*, and if no protoplasmic connections could be seen it was

assumed that they were probaly too fine to be visible with the magnification used or with the fixing and mounting media employed. Until the Volvocaceae have been studied in all quarters

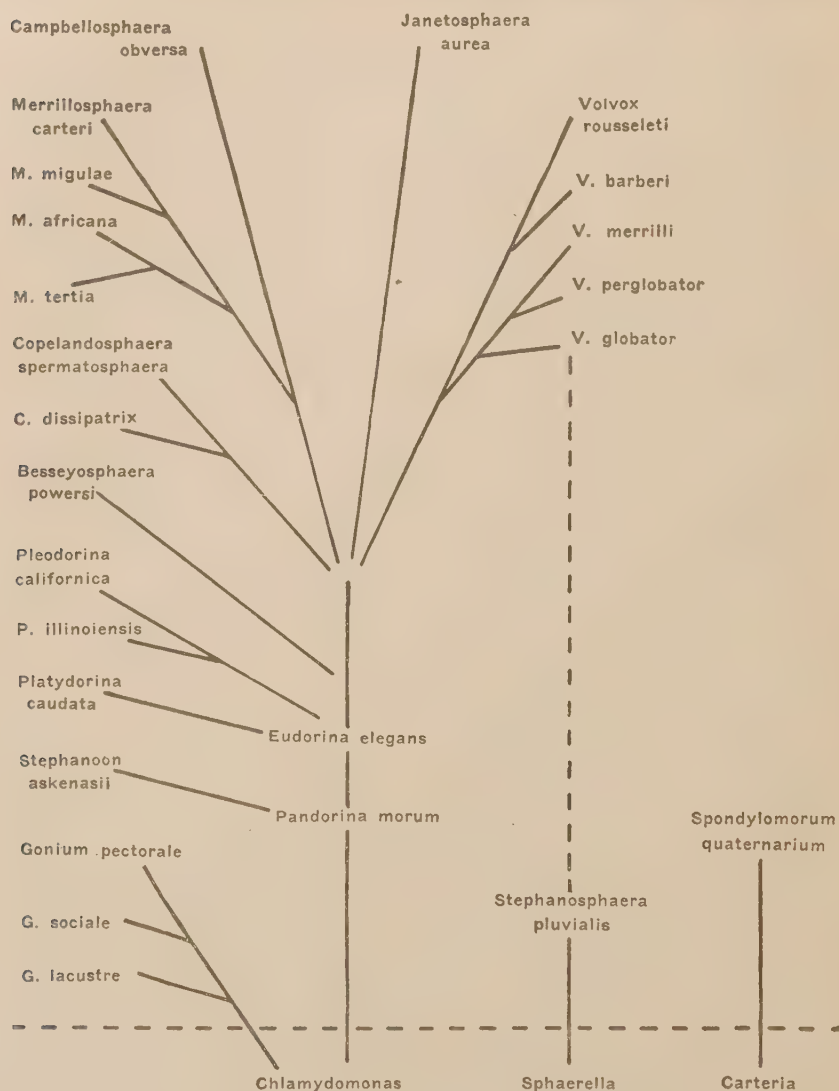


FIG. 2. The phylogeny of the Volvocaceae. All the genera above the horizontal line are of this subfamily except *Stephanosphaera* and *Spondylomorom*. The latter are sometimes so treated for convenience. The genera below the horizontal line are unicellular.

of the globe it will be conducive to more discriminating investigation of the members of the group if the species remain segregated in their several genera. Subgenera are not equally

adapted to this end. There is reason to believe that, as was pointed out by Powers ('08 p. 170), European workers have encountered in their own region species that have not received due recognition until found elsewhere.

My present view, in December, 1921, of the relationships of *Copelandosphaera* is indicated by the diagram of the phylogeny of the Volvoceae given in fig. 2. The broken line from *Stephanosphaera* to *Volvox* is a reminder of the view advanced by Crow ('18) that *Volvox* and *Janetosphaera* are allied to *Sphaerella* rather than to *Chlamydomonas*. According to his view the species shown here should be represented as forming two genetic trees instead of one.

#### KEYS TO THE GENERA AND SPECIES OF THE SUBFAMILY VOLVOCEAE

##### *Key to the genera.*

1. Coenobium a plate of biciliate cells.
  2. Cells all facing with one side of plate..... *Gonium*.
  2. Some cells facing with each side of plate..... *Platydorina*.
1. Coenobium globose, ellipsoidal or ovoid.
  2. Cells on equatorial belt, facing outward..... *Stephanoon*.
  2. Cells in entire surface of spheroid.
    3. Cells all alike.
      4. Inner sides of cells pyramidal..... *Pandorina*.
      4. Cells globose ..... *Eudorina*.
    3. Vegetative cells differentiated.
      4. No vegetative cells in reproductive area..... *Pleodorina*.
      4. Vegetative cells in reproductive area.
        5. Gonidia differentiated after birth..... *Besseyosphaera*.
        5. Gonidia differentiated before birth.
          6. No intercellular protoplasmic strands.
            7. Gonidia not differentiated in young embryos.
 

*Copelandosphaera*.
            7. Gonidia differentiated in young embryos; becoming very large.
              8. Gonidia not migratory in embryos..... *Merrillosphaera*.
              8. Gonidia migratory in embryos..... *Campbelloosphaera*.
        6. Cells connected by intercellular protoplasmic strands.
          7. Cells round; without separate inner walls.... *Janetosphaera*.
          7. Cells stellate; with separate inner walls..... *Volvox*.

##### *Key to the species.*

##### GONIUM

1. Cells 16..... *G. pectorale* Müll.
1. Cells 4.
  2. Cilia vibratile throughout..... *G. sociale* (Duj.) Warm.
  2. Cilia vibratile only in terminal half..... *G. lacustre* West.

##### PLATYDORINA

- Cells 16 or 32, arranged in a horseshoe-shaped plate, those of the two faces intercalated; posterior end with 3 or 5 tails..... *P. caudata* Kofoid.

## STEPHANOON

Cells 16, in two alternating rows on the equator..... *S. askenasi* Schewk.

## PANDORINA

Cells 16 or 32, crowded, each with a single chromatophore and pyrenoid.  
*P. morum* Bory.

## EUDORINA

Cells 16, 32, or 64..... *E. elegans* Ehrenb.

## PLEODORINA

Cells 32, rarely 16 or 64; gonidia not more than twice the diameter of the vegetative cells which constitute the anterior quartet.

*P. illinoisensis* Kofoid.

Cells nearly 128, rarely 64, 32, or fewer; gonidia about two to three times the diameter of the vegetative cells; vegetative cells constituting the greater part of the anterior hemisphere..... *P. californica* Shaw.

## BESSEYOSPHAERA

Cells about 1,000; gonidia 10 to 78, distributed in two-thirds to four-fifths of the coenobium, developed in daughters after birth.

*B. powersi* (Powers) Shaw.

## COPELANDOSPHAERA

Cells 9,000 to 25,000 or more; gonidia 4 to 15; sperm platelets in monoecious coenobia ..... *C. dissipatrix* sp. nov.

Cells 1,000 to 3,000; gonidia 1 to 25; sperm platelets in sperm spheres.

*C. spermatosphaera* (Powers) comb. nov.

## MERRILLOSPHAERA

1. Coenobia strongly ovoid; gonidia in pairs; those of the posterior pair the smaller..... *M. africana* (West) Shaw.

1. Coenobia subglobose or ellipsoidal; gonidia mostly about equal and in fours.

2. Gonidia and oogonidia in separate coenobia.... *M. carteri* (Stein) Shaw.

2. Gonidia and oogonidia in the same coenobia.

3. Oospores of about the same number as the gonidia.

*M. migulae* Shaw.

3. Oospores more numerous than gonidia..... *M. tertia* (Meyer) Shaw.

## CAMPBELLOSPHAERA

Gonidia 8 or less; anterior gonidia usually the smaller when not all are alike..... *C. obversa* Shaw.

## JANETOSPHAERA

Oospores with eccentric double walls..... *J. aureus* (Ehrenb.) Shaw.

## VOLVOX

1. Oospore walls angularly wavy..... *V. globator* (L.) Ehrenb.

1. Oospore walls crenate..... *V. perglobator* Powers.

1. Oospore walls spinose.

2. Sexual coenobia dioecious..... *V. rousseleti* West.

2. Sexual coenobia monoecious.

3. Somatic protoplasts large and broad..... *V. merrilli* Shaw.

3. Somatic protoplasts small and narrow..... *V. barberi* Shaw.



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## ILLUSTRATIONS

[Photomicrographs of *Copelandosphaera dissipatrix* sp. nov. from specimens mounted in glycerine and Venetian turpentine, taken by W. R. Shaw and E. Cortes at the Bureau of Science, Manila.]

### PLATE 1

- FIG. 1. Sexual coenobium, mounted in glycerine, containing about one hundred twenty-seven oogonidia and seven antheridia. Four of the antheridia appear in the photograph, two presenting a surface view and two an edge view.  $\times 100$ .
2. A portion of the same specimen showing the two antheridia that present a surface view and four of the oogonidia. Most of the somatic cells are out of focus in the photograph, though some near the ends of the figure, along the line between the dark and light protoplasts, are in focus.  $\times$  about 200.
3. A portion of the same specimen on a larger scale. The scale at the right is a part of a stage micrometer scale with smallest divisions of  $10\ \mu$  that was photographed on the same plate and with the same adjustment of apparatus that was used for the specimen.  $\times$  about 405.

### PLATE 2

- FIG. 4. A nearly mature sexual coenobium in glycerine. The oogonidia on the lower side are more nearly in focus than those on the upper side. Number of oogonidia counted, 130.  $\times 50$ .
5. A nearly mature sexual coenobium in glycerine. Number of oogonidia counted, 112.  $\times 50$ .
6. An asexual coenobium, the type specimen, in Venetian turpentine. This is shown on a larger scale in Plate 3, fig. 13.  $\times 50$ .
7. An asexual coenobium in glycerine. It has four daughters in about the 1,024-celled stage.  $\times 50$ .
8. An asexual coenobium in glycerine. It has fifteen embryonic daughters in about the 64-celled stage. The photograph shows the open phialopores of those embryos that face them toward the observer.  $\times 100$ .
9. An asexual coenobium in Venetian turpentine. It has ten daughter coenobia. Of these eight contain gonidia and in two no reproductive cells are yet differentiated. These are probably sexual daughters.  $\times 100$ .
10. An asexual coenobium in glycerine. It has eight embryonic daughters that are in the 256- or 512-celled stage.  $\times 50$ .

### PLATE 3

- FIG. 11. An asexual coenobium, in glycerine. It contains ten embryonic daughters.  $\times 100$ .
12. Part of a sexual coenobium in Venetian turpentine. It shows some immature oospores and some flask-shaped unicellular algae that are embedded in the membranes of the somatic cells.  $\times 400$ .

13. The type specimen of *Copelandosphaera dissipatrix* in Venetian turpentine. It contains nine daughters which in turn contain gonidia or embryos of two or four cells. A number of flask-shaped unicellular algae are embedded in the membranes of the somatic layer.  $\times 100$ .

## PLATE 4

- FIG. 14. An asexual coenobium with ten daughters, in glycerine.  $\times 100$ .
15. A sexual coenobium in Venetian turpentine, very much shrunken, of which a part is shown in Plate 3, fig. 12. It contains eighty-one reproductive bodies. Of these seventy-one have begun to develop spore walls.  $\times 100$ .
  16. An asexual coenobium with six daughters, in glycerine.  $\times 100$ .

## TEXT FIGURES

- FIG. 1. Optical section through mother and daughter coenobia of the type specimen, in Venetian turpentine.
2. The phylogeny of the Volvoceae.



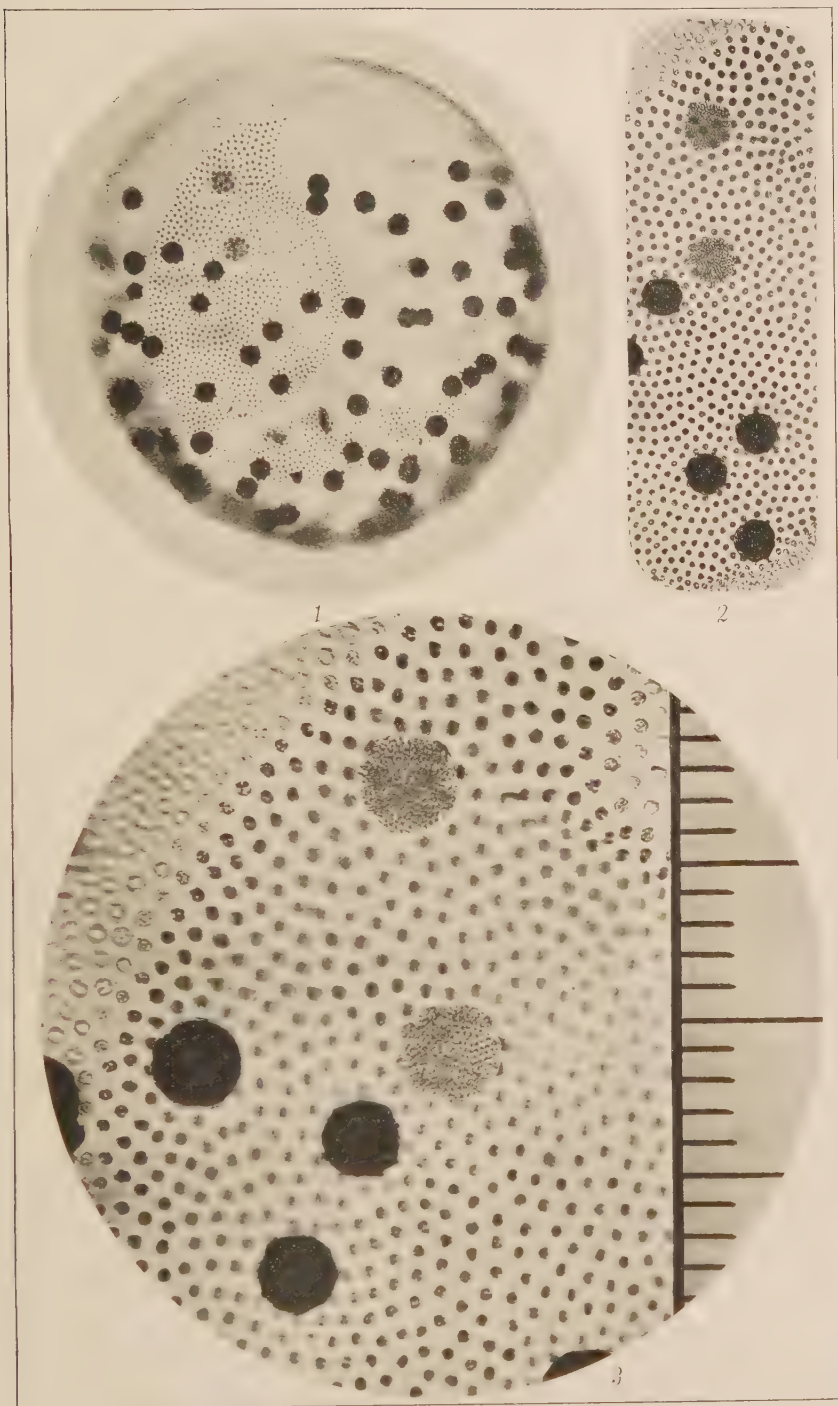


PLATE 1. COPELANDOSPHAERA DISSIPATRIX SP. NOV.





PLATE 2. COPELANDOSPHAERA DISSIPATRIX SP. NOV.





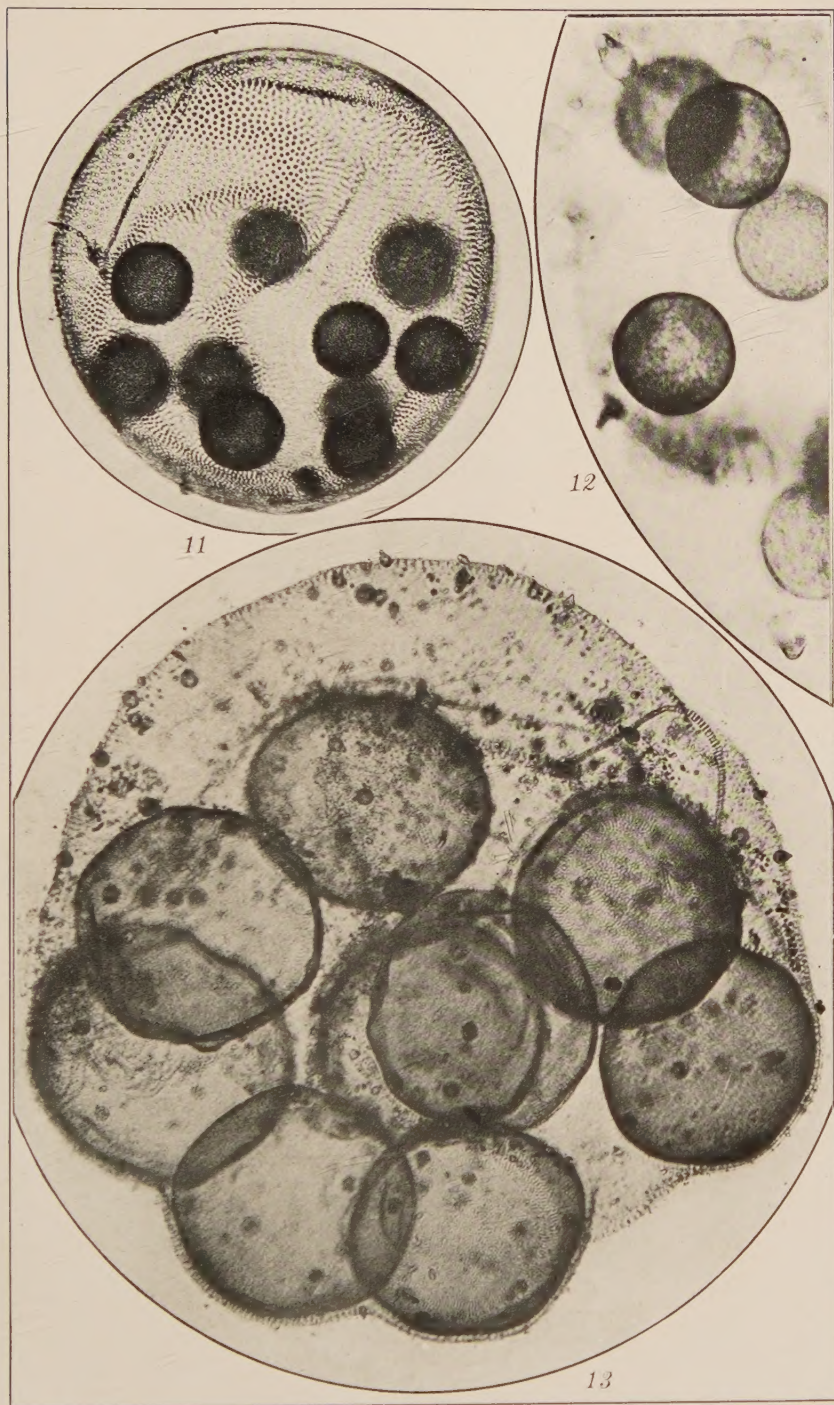


PLATE 3. COPELANDOSPHAERA DISSIPATRIX SP. NOV.







PLATE 4. COPELANDOSPHAERA DISSIPATRIX SP. NOV.

